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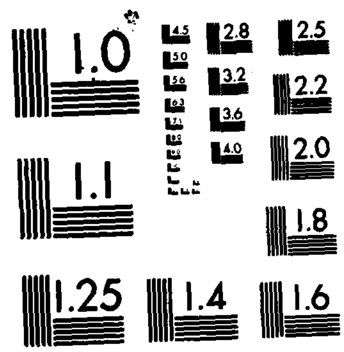

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

Introduction

Technology does not evolve in a sterile environment. The nature and rate of technological change are inexorably bound with socio-economic phenomena. Technology, when introduced, may alter historic social and economic relationships. At present, the precise factors which induce technological innovation are not known. Such change is indicated by factors which measure economic and social growth. The purpose of technology assessment is to identify and measure the social effects of innovation. As of yet, the identification has been more successful than measurement of effects. It is difficult to measure that which is little understood. The measurement problem exists because effects are often multifarious. For example, it is clear that the telephone has yielded major social change. It has altered the conduct of personal and business communications. It has brought places and persons of vast geographical distances together. Yet one cannot fully grasp or measure the effects of the telephone.

It seems reasonable that the retrospective identification and measurement of social effects due to technology innovation could be accomplished, as the events that induced such change and the attendant results are locked in history. Yet, the thought of measuring the effects of the telephone are bewildering.

Since the problems of measuring the effects of accepted technology are difficult, the problems of estimating impacts of future technology on distant socio-economic settings require additional considerations. As the future is not locked in history, variations of future social settings will change the magnitude and timing of effects. Since the future is not known, it is reasonable to posit likely scenarios within which to consider the impact of technology. A brief review of history indicates that society does not follow a predictable pattern. However, one may posit future scenarios as bounds for which there seems to be a reasonable probability of occurance. The scenarios presented in this section are such bounds.

The purpose of this section is to present three reasonable future societal options within which one may consider the impact of aviation communications technology. The information contained in succeeding sections provides only the glimpse of future bounds necessary for the conduct of the study. Speculation for speculation sake has been eliminated. That is, the scenarios contain only those factors found necessary to examine the primary impacts of technology.

Scenario Themes and Overviews

The following three themes were used to characterize the alternative future scenarios: "Balanced Growth", "Rapid Growth", and "Stagflation". The official FAA aviation forecasts extrapolate the present to the year 1992 on the basis of four scenarios: "Baseline", "High Prosperity", "Energy Conservation", and "Slow Growth"(1). The socio-economic assumptions underlying the FAA's scenarios were used as the basis for the construction of the scenarios used in this study. The alternative scenarios correspond to the FAA scenarios in the following manner:

TECHNOLOGY FORECAST SCENARIOS	FAA SCENARIOS
Balanced Growth ------------------	Baseline
Rapid Growth ---------------------	High Prosperity
Stagflation ----------------------	Slow Growth

The time period considered in the present study is 1985 to 2020. The historic and forecast data developed in the FAA document have been taken as fact for the purposes of the present study. Although a plethora of variables could be used in the construction of the scenarios, the research in this report demonstrates that only a select few variables, also used in the FAA forecast need be considered. These measures included the following three economic variables, gross national product (GNP), disposable personal income

(DPI) and civilian employment. Measures of aviation activity used in this study include:

- aircraft operations;
- size and composition of the active general aviation fleet;
- size of the air carrier fleet;
- size and composition of the cadre of pilots; and,
- measures of FAA air traffic control measures; e.g. aircraft handled, IFR departures, pilot briefings, etc.

The measures estimated for the three scenarios included in this report are consistent with those included in the recent FAA forecast.

Examination of the FAA aviation forecasts indicates that the "Baseline" scenario forecast shows moderate economic growth rates with a decline in unemployment and inflation. The "High Prosperity" and "Slow Growth" scenarios werebased on modifications of the "Baseline" forecast. The "High Prosperity" scenario assumes growth rates and related economic conditions similar to those experienced in the U.S. between 1961 and 1966. On the other hand, the "Slow Growth" scenario assumes growth rates and related conditions similar to those that prevailed in the U.S. between 1971 and 1975. The socio-economic phenomena associated with the FAA scenarios are expanded in time to develop the alternative scenarios detailed in this report(2).

Overview of Balanced Growth Scenario

The Balanced Growth Scenario depicts a society that has deliberately constrained economic and technological growth in order to allay negative social and economic impacts derived from uncontrolled growth. Contrary to the past, a mutually cooperative relationship exists between government and private industry allowing for the attainment of specific social goals. Government intervention in the affairs of private industry is of a twofold nature. Government regulations serve to establish and maintain an increasingly competitive market structure in all industries. Simultaneously, the government examines industries' compliance with regulations designed to promote social welfare. The latter govermental task is executed in a manner that places minimal restrictions on economic and technological development and growth for all industries.

Population growth continues with a fertility rate equal to the replacement level. The result is that the U.S. slowly approaches "zero population growth". The population distribution patterns for this scenario exhibit an increasing populace in small cities, towns and rehabilitated inner cities.

Overview of Rapid Growth

The Rapid Growth scenario portrays a society where technological change is the driving force in societal transition. National policy reflects the attitudes of society, as the government takes minimal steps to influence the rate and direction of technological

and economic change. Government intervention in private industry is limited to enforcing regulations that allow for maximum competition and efficiency within market structures. Therefore, the development of new technology is limited only by market forces.

The nation's population increases as the fertility rate approaches post World War II levels and the replacement rate remains constant. Population distribution patterns reveal continual suburban development in the Southwest, Eastern and Great Lake Regions.

Overview of Stagflation

In the Stagflation Scenario social goals or objectives are in conflict with the nature and direction of technological change. As such, technological innovation is inhibited, since social objectives include the minimization of the untoward effects of technology without consideration of the benefits.

Attempts to formulate and implement a national policy for controlled economic and technological growth meet with uniform opposition from industrial interest. As such, the relationship between industry and government deteriorates. Government programs result in gerrymander regulations and laws that retard economic and technological growth. Industrial productivity decreases, unemployment increases, and inflation continues to diminish the currency. The lack of social progress increases social pressures to effect changes through increased government activity. One result of increased government activity is to reverse the deregu-

lation trend initiated in the 1970's. Previously regulated communications industries are subject to new regulation in the public interest.

Balanced Growth Scenario

In the Balanced Growth Scenario economic and technological growth is assumed to occur at a slow but constant rate. Government intervention into private industry affairs serves to promote highly competitive market structures while simultaneously fostering social welfare. Inflation and unemployment are reduced as the general level of affluence rises gradually but steadily.

Balanced Growth Economy

The balance between economic and technological growth and social needs results in modest economic growth. Industrial production increases at a slow but constant rate, consistent with national policy. Throughout the forecast period, GNP rises at an average annual rate of 2.8%. GNP expressed in 1972 dollars doubles in a twenty-four year period from $1740 trillion in 1985 to $3480 trillion by the year 2009. By the year 2020, GNP will increase 170% over the 1985 level to $4700 trillion. Disposable personal income increases at an average annual rate of 3.01% throughout the forecast period. Expressed in 1972 dollars, disposable personal income doubles in the first twenty-four year period of the forecast to $2500 trillion. By the year 2020, disposable personal income will increase 191% from $1250 trillion in 1985 to $3640

trillion. Throughout the forecast period, civilian employment experiences a steady increase at an average annual rate of 1.16%. From 1985 to the year 2020, civilian employment increases 51% from 104.3 million workers to 158 million workers. Data for the period 1985 - 2020 for each economic variable are presented in Table B-1.

The expected values for the economic variables will have a significant impact upon the aviation and communication industries. GNP, a measure of industrial production, constantly increases during the forecast period. The rise in industrial activity reveals potential for an increase in the utilization of general aviation transportation by private industry. Factors increasing the utilization of general aviation transportation by private industry include the following:

- Cost saving advantage for some travel distances and geographical areas;
- Business dispersions and centralized management;
- Changing air route structures; and,
- Rapid escalation of fuel prices.

GNP, a measure of the level of investment, indicates that capital will be available during the forecast period for the development of sophisticated communciation technology required to control the increasing levels of air traffic.

As indicated previously, disposable personal income, (a measure of consumer purchasing power) and civilian employment increase

FORECASTED BALANCED GROWTH ECONOMIC VARIABLES 15:17 TUESDAY, FEBRUARY 3, 1981 4

OBS	YR	BEMPLOY	BGNP	BDPI
1	1985	104.3	1740	1250
2	1986	105.7	1782	1296
3	1987	107.1	1822	1342
4	1988	108.5	1862	1388
5	1989	109.9	1902	1434
6	1990	111.3	1950	1480
7	1991	112.8	2025	1532
8	1992	114.2	2100	1584
9	1993	115.7	2175	1636
10	1994	117.2	2250	1688
11	1995	118.7	2325	1740
12	1996	120.3	2400	1792
13	1997	121.8	2475	1844
14	1998	123.4	2550	1896
15	1999	125.0	2625	1948
16	2000	126.6	2700	2000
17	2001	128.3	2790	2067
18	2002	129.9	2880	2134
19	2003	131.6	2970	2201
20	2004	133.4	3060	2268
21	2005	135.1	3150	2335
22	2006	136.8	3240	2402
23	2007	138.6	3330	2469
24	2008	140.4	3420	2536
25	2009	142.3	3510	2603
26	2010	144.1	3600	2670
27	2011	145.9	3710	2767
28	2012	147.8	3820	2867
29	2013	149.8	3930	2961
30	2014	150.8	4040	3155
31	2015	152.0	4150	3155
32	2016	153.2	4260	3252
33	2017	154.4	4370	3349
34	2018	155.6	4480	3446
35	2019	156.8	4590	3543
36	2020	158.0	4700	3640

TABLE 1

steadily throughout the forecast period. The increased values of these economic variables implies that more individuals will become involved with aviation transportation. This phenomena will occur because of the increasing number of individuals who will be able to afford air transporation services.

Aviation Industry

Throughout the forecast period, the demand for air transportation is evidenced in the size and composition of the general aviation fleet mix. The total number of aircraft in the general aviation fleet increases at an average annual rate of 1.3% throughout the forecast period. Between 1985 and the year 2020, the general aviation fleet increases by 62% from 254,000 to 413,000 aircraft. Private industry's increased demand for heavier more sophisticated aircraft accounts for the slow but increasing growth of multi-engine aircraft active in the general aviation fleet. Throughout the forecast period the number of multiengine aircraft in the general aviation fleet increase at an average annual rate of 1.6%. Between 1985 and the year 2020, the number of active multiengine aircraft in the general aviation fleet increases by 82% from 28,709 to 52,174 multiengine aircraft. The increase in the number of single-engine aircraft active in the general aviation fleet is a result of a combination of industrial and public demand for air transportation. The number of single-engine aircraft, used primarily for private and instructional flying, increases at an average annual rate of 1.2% throughout the forecast period.

Between 1985 and 2020, the number of active single-engine aircraft in the general aviation fleet rises 56% from 202,481 to 315,264 single-engine aircraft. The numbers and types of aircraft projected to be active in the general aviation fleet mix is shown in Table B-2 for the three alternative scenarios. The general aviation fleet mix for the Balanced Growth Scenario is presented in Figure B-1.

The effects of the projected demand levels on air transportation is reflected also in FAA workload measures. FAA provides the aviation community with several operational services including the following two activities: air traffic control at FAA towered airports and traffic surveillance and separation at Air Route Traffic Control Centers. The need for FAA operational services will increase as a result of growth in aviation activity. Total aircraft operations at FAA towered airports are projected to increase at an average annual rate of 1.9% throughout the forecast period. Between 1985 and 2020, total aircraft operations at FAA towered airports increase 101% from 83 million to 166 million aircraft operations. Itinerant aircraft operations rise at an average annual rate of 1.7% throughout the forecast period. Between 1985 and the year 2020, itinerant aircraft operations at FAA towered airports increases 86% from 55.9 million operations to 104.3 million operations. The increase in itinerant operations reflects both the increases in utilization of general aviation by business and the increase in demand for air carrier services by

S T A T I S T I C A L   A N A L Y S I S   S Y S T E M   11:47 MONDAY, DECEMBER 8, 1980   1

OBS	YR	T	BTOTGA	RTOTGA	STOTGA	BSEGA	RSEGA	SSEGA	BMEGA	RMEGA	SMEGA	BOGA	ROGA	SOGA
1	1985	10	254.871	264.975	248.542	202.481	209.826	197.622	28.7087	29.8456	25.4538	23.6814	25.3029	25.4656
2	1986	11	264.042	277.280	254.167	209.235	218.959	201.760	29.6851	31.0952	26.0600	25.1216	27.2252	26.3472
3	1987	12	273.008	289.800	259.167	215.809	228.239	205.428	30.6577	32.3785	26.6662	26.5413	29.1826	27.0732
4	1988	13	281.740	302.508	263.587	222.183	237.646	208.662	31.6243	33.6949	27.2724	27.9323	31.1667	27.6522
5	1989	14	290.213	315.374	267.474	228.343	247.162	211.501	32.5826	35.0438	27.8786	29.2872	33.1681	28.0943
6	1990	15	298.404	328.367	270.879	234.274	256.766	213.984	33.5305	36.4241	28.4848	30.5992	35.1774	28.4105
7	1991	16	306.294	341.455	273.850	239.966	266.436	216.147	34.4658	37.8349	29.0910	31.8624	37.1844	28.6123
8	1992	17	313.869	354.605	276.435	245.411	276.151	218.026	35.3867	39.2751	29.6972	33.0718	39.1790	28.7111
9	1993	18	321.118	367.781	278.676	250.604	285.887	219.655	36.2912	40.7432	30.3034	34.2234	41.1508	28.7180
10	1994	19	328.033	380.950	280.616	255.541	295.623	221.063	37.1776	42.2379	30.9096	35.3140	43.0896	28.6434
11	1995	20	334.610	394.079	282.290	260.224	305.336	222.278	38.0445	43.7575	31.5158	36.3416	44.9854	28.4968
12	1996	21	340.847	407.132	283.733	264.652	315.003	223.324	38.8905	45.3004	32.1220	37.3047	46.8285	28.2873
13	1997	22	346.747	420.077	284.975	268.830	324.602	224.224	39.7143	46.8648	32.7282	38.2028	48.6095	28.0227
14	1998	23	352.313	432.882	286.042	272.762	334.113	224.997	40.5149	48.4487	33.3344	39.0362	50.3200	27.7101
15	1999	24	357.551	445.516	286.957	276.454	343.514	225.661	41.2914	50.0500	33.9406	39.8059	51.9520	27.3561
16	2000	25	362.471	457.952	287.742	279.915	352.787	226.229	42.0431	51.6666	34.5468	40.5131	53.4984	26.9661
17	2001	26	367.081	470.161	288.415	283.151	361.912	226.717	42.7694	53.2963	35.1530	41.1600	54.9529	26.5451
18	2002	27	371.392	482.119	288.990	286.173	370.872	227.134	43.4700	54.9367	35.7592	41.7488	56.3103	26.0975
19	2003	28	375.416	493.803	289.483	288.989	379.652	227.491	44.1445	56.5855	36.3654	42.2822	57.5663	25.6269
20	2004	29	379.166	505.194	289.904	291.610	388.236	227.796	44.7929	58.2402	36.9716	42.7631	58.7176	25.1365
21	2005	30	382.655	516.274	290.264	294.045	396.614	228.057	45.4152	59.8984	37.5778	43.1945	59.7620	24.6293
22	2006	31	385.896	527.028	290.571	296.305	404.772	228.280	46.0115	61.5576	38.1840	43.5796	60.6981	24.1076
23	2007	32	388.902	537.442	290.834	298.399	412.701	228.470	46.5820	63.2153	38.7902	43.9215	61.5256	23.5735
24	2008	33	391.687	547.508	291.058	300.337	420.394	228.633	47.1271	64.8690	39.3964	44.2233	62.2450	23.0289
25	2009	34	394.265	557.217	291.249	302.129	427.843	228.771	47.6473	66.5163	40.0026	44.4883	62.8579	22.4751
26	2010	35	396.647	566.564	291.412	303.785	435.043	228.890	48.1430	68.1547	40.6088	44.7194	63.3663	21.9137
27	2011	36	398.847	575.547	291.552	305.312	441.992	228.991	48.6148	69.7819	41.2150	44.9196	63.7732	21.3456
28	2012	37	400.876	584.163	291.670	306.721	448.685	229.077	49.0634	71.3956	41.8212	45.0917	64.0821	20.7719
29	2013	38	402.746	592.414	291.772	308.018	455.123	229.151	49.4893	72.9935	42.4274	45.2382	64.2971	20.1934
30	2014	39	404.468	600.302	291.858	309.213	461.306	229.214	49.8934	74.5736	43.0336	45.3617	64.4225	19.6108
31	2015	40	406.053	607.832	291.932	310.312	467.235	229.267	50.2763	76.1337	43.6398	45.4646	64.4633	19.0247
32	2016	41	407.510	615.009	291.995	311.323	472.912	229.313	50.6389	77.6720	44.2460	45.5490	64.4246	18.4357
33	2017	42	408.850	621.840	292.048	312.251	478.341	229.352	50.9819	79.1867	44.8522	45.6169	64.3117	17.8441
34	2018	43	410.080	628.333	292.094	313.104	483.526	229.385	51.3061	80.6761	45.4584	45.6702	64.1302	17.2503
35	2019	44	411.210	634.496	292.133	313.887	488.472	229.414	51.6122	82.1386	46.0646	45.7106	63.8854	16.6547
36	2020	45	412.246	640.340	292.166	314.605	493.184	229.438	51.9011	83.5728	46.6708	45.7397	63.5829	16.0575
37	2021	46	413.196	645.874	292.195	315.264	497.668	229.459	52.1735	84.9775	47.2770	45.7588	63.2283	15.4590

TABLE 2

G.A. AIRCRAFT BALANCED GROWTH

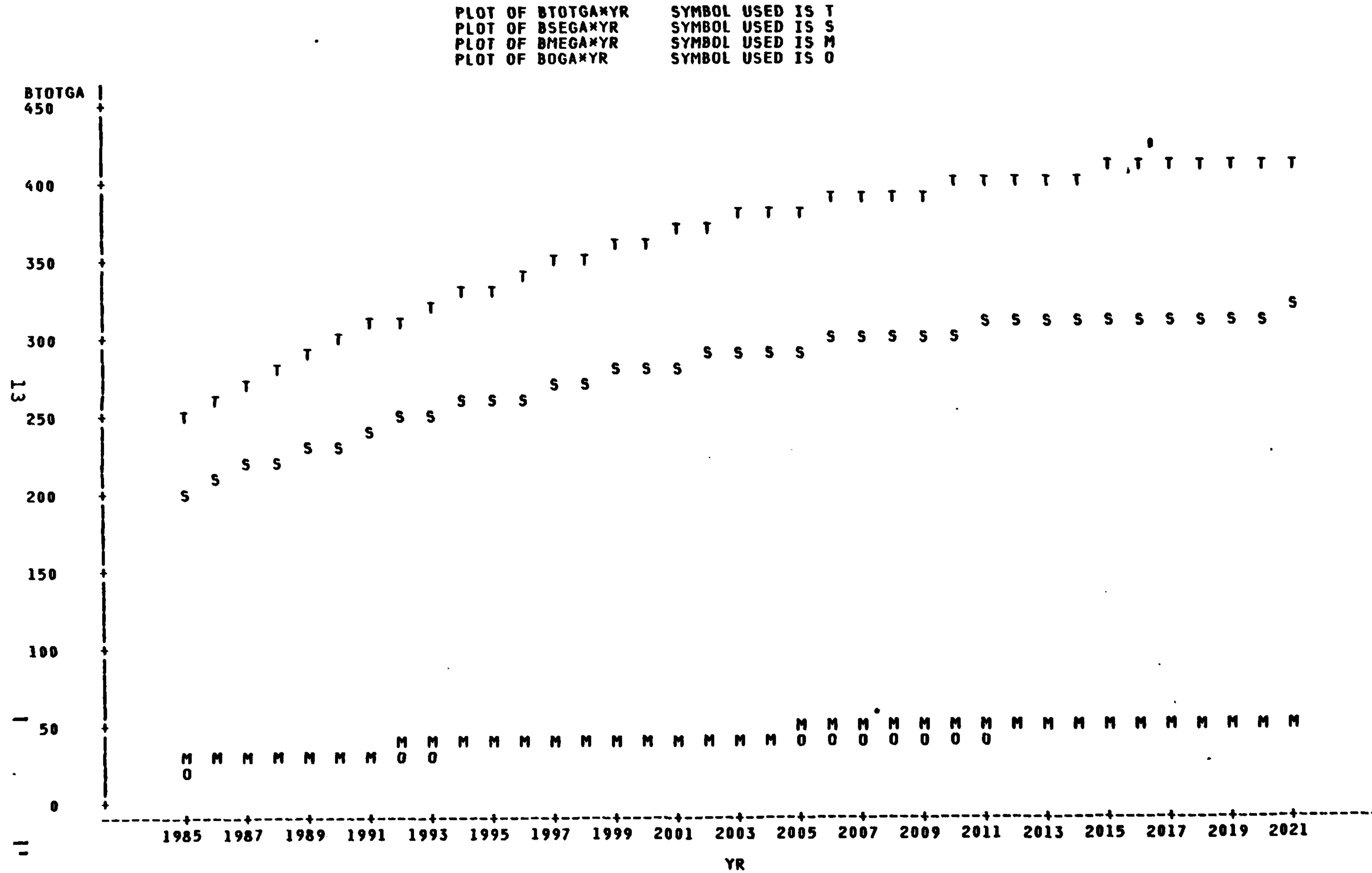

FIGURE 1

the general public. Local aircraft operations increases at an average annual rate of 2.3% throughout the forecast period. Between 1985 and the year 2020, local aircraft operations performed at FAA towered airports increase 131% from 27 million to 62 million. The increase in local aircraft operations derives from an increase in pilot instruction which will in turn create more air traffic after students become licensed pilots. The complete tabulations for FAA towered airport workload measures are given in Table B-3. The measures displayed graphically in Figure B-2 are the FAA towered airport workload measures for the Balanced Growth Scenario.

The growth in the number of aircraft handled by the Air Route Traffic Control Centers increases at an average annual rate of 1.7% throughout the forecast period. From 1985 to 2020, total IFR aircraft handled by Air Route Traffic Centers increases 88% from 36 million to 68 million aircraft. The increases in operations at Air Route Traffic Control Centers will be a result of increase in general aviation traffic associated with increases in pilot capabilities and an increased use of larger more sophisticated aircraft. The complete tabulations of enroute center work measures are given in Table B-4. The enroute work measures for the Balanced Growth Scenario are displayed graphically in Figure B-3.

OBS	YR	T	BTOPS	RTOPS	STOPS	BITOPS	RITOPS	SITOPS	BLOPS	RLOPS	SLOPS
1	1985	15	83.012	96.249	80.121	55.927	67.316	53.7079	27.0859	28.9331	26.4126
2	1986	16	85.412	99.862	81.810	57.714	70.102	54.9736	27.6973	29.7598	26.8366
3	1987	17	87.835	103.474	83.450	59.503	72.888	56.1922	28.3314	30.5865	27.2582
4	1988	18	90.279	107.087	85.039	61.290	75.674	57.3623	28.9894	31.4132	27.6771
5	1989	19	92.744	110.699	86.576	63.071	78.459	58.4831	29.6722	32.2399	28.0929
6	1990	20	95.225	114.312	88.059	64.844	81.245	59.5539	30.3806	33.0666	28.5050
7	1991	21	97.720	117.924	89.487	66.605	84.031	60.5745	31.1153	33.8933	28.9129
8	1992	22	100.227	121.537	90.861	68.350	86.817	61.5452	31.8769	34.7200	29.3161
9	1993	23	102.743	125.149	92.180	70.078	89.603	62.4663	32.6658	35.5467	29.7139
10	1994	24	105.266	128.762	93.444	71.784	92.388	63.3387	33.4822	36.3734	30.1058
11	1995	25	107.792	132.374	94.654	73.466	95.174	64.1634	34.3261	37.2001	30.4911
12	1996	26	110.320	135.987	95.811	75.122	97.960	64.9415	35.1975	38.0268	30.8692
13	1997	27	112.845	139.599	96.914	76.750	100.746	65.6744	36.0960	38.8535	31.2397
14	1998	28	115.367	143.212	97.966	78.346	103.532	66.3636	37.0210	39.6802	31.6019
15	1999	29	117.881	146.824	98.966	79.909	106.317	67.0108	37.9720	40.5069	31.9555
16	2000	30	120.385	150.437	99.918	81.437	109.103	67.6176	38.9481	41.3336	32.3000
17	2001	31	122.877	154.049	100.821	82.928	111.889	68.1859	39.9483	42.1603	32.6350
18	2002	32	125.353	157.662	101.678	84.382	114.675	68.7173	40.9713	42.9870	32.9603
19	2003	33	127.812	161.274	102.489	85.796	117.461	69.2137	42.0159	43.8137	33.2755
20	2004	34	130.251	164.887	103.258	87.171	120.246	69.6769	43.0806	44.6404	33.5806
21	2005	35	132.668	168.499	103.984	88.504	123.032	70.1087	44.1639	45.4671	33.8752
22	2006	36	135.060	172.112	104.670	89.796	125.818	70.5109	45.2640	46.2938	34.1595
23	2007	37	137.426	175.724	105.318	91.046	128.604	70.8850	46.3792	47.1205	34.4332
24	2008	38	139.762	179.337	105.929	92.254	131.390	71.2328	47.5077	47.9472	34.6965
25	2009	39	142.068	182.949	106.505	93.420	134.175	71.5560	48.6475	48.7739	34.9494
26	2010	40	144.341	186.562	107.048	94.544	136.961	71.8559	49.7968	49.6006	35.1919
27	2011	41	146.579	190.174	107.558	95.625	139.747	72.1342	50.9536	50.4273	35.4242
28	2012	42	148.782	193.787	108.039	96.666	142.533	72.3922	52.1159	51.2540	35.6466
29	2013	43	150.947	197.399	108.490	97.665	145.319	72.6313	53.2817	52.0807	35.8590
30	2014	44	153.073	201.012	108.915	98.624	148.104	72.8527	54.4491	52.9074	36.0619
31	2015	45	155.160	204.624	109.313	99.543	150.890	73.0576	55.6163	53.7341	36.2554
32	2016	46	157.205	208.237	109.687	100.424	153.676	73.2472	56.7813	54.5608	36.4397
33	2017	47	159.209	211.849	110.038	101.266	156.462	73.4226	57.9423	55.3875	36.6152
34	2018	48	161.169	215.462	110.367	102.072	159.248	73.5847	59.0975	56.2142	36.7821
35	2019	49	163.086	219.074	110.675	102.841	162.033	73.7346	60.2454	57.0409	36.9407
36	2020	50	164.959	222.687	110.964	103.575	164.819	73.8730	61.3843	57.8676	37.0913
37	2021	51	166.788	226.299	111.235	104.275	167.605	74.0009	62.5127	58.6943	37.2342

TABLE 3

BALANCED GROWTH OPERATIONS

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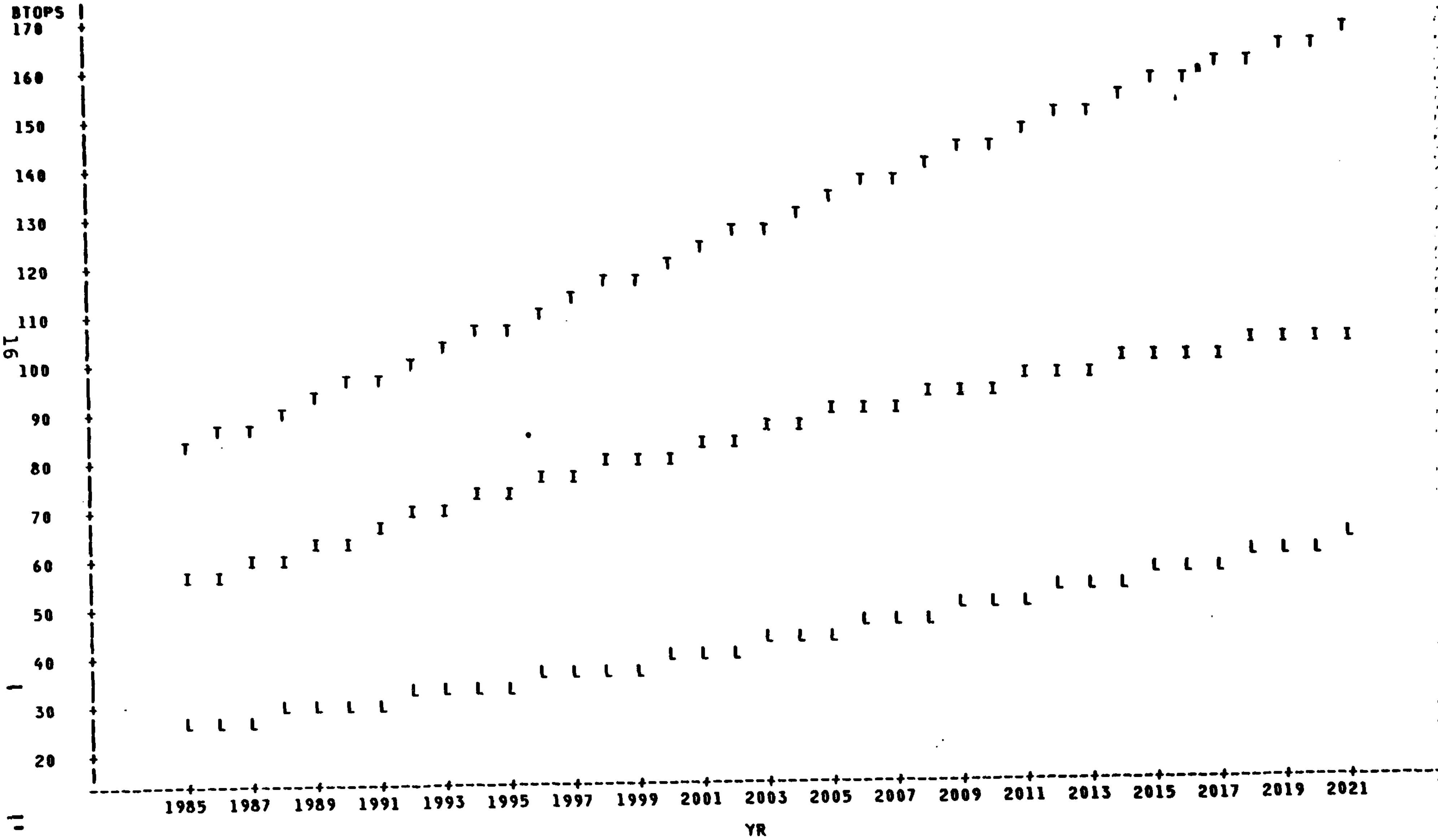

FIGURE 2

S T A T I S T I C A L   A N A L Y S I S   S Y S T E M   17:06 MONDAY, DECEMBER 8, 1980   1

OBS	YR	T	BHAND	RHAND	SHAND	BDEP	RDEP	SDEP	BOVERS	ROVERS	SOVERS
1	1985	15	36.3731	43.118	34.8851	14.4762	17.4614	13.8709	7.3637	7.6117	7.16895
2	1986	16	37.5891	44.984	35.7551	15.0014	18.2586	14.2429	7.5306	7.8277	7.29822
3	1987	17	38.8057	46.851	36.5936	15.5312	19.0558	14.6032	7.6924	8.0437	7.42035
4	1988	18	40.0201	48.718	37.3994	16.0645	19.8530	14.9511	7.8487	8.2597	7.53547
5	1989	19	41.2300	50.585	38.1716	16.6005	20.6502	15.2861	7.9995	8.4757	7.64371
6	1990	20	42.4329	52.451	38.9098	17.1381	21.4474	15.6078	8.1445	8.6917	7.74527
7	1991	21	43.6263	54.318	39.6137	17.6762	22.2446	15.9159	8.2839	8.9077	7.84037
8	1992	22	44.8079	56.185	40.2833	18.2139	23.0418	16.2103	8.4174	9.1237	7.92923
9	1993	23	45.9756	58.051	40.9187	18.7502	23.8390	16.4908	8.5452	9.3397	8.01213
10	1994	24	47.1271	59.918	41.5205	19.2840	24.6362	16.7577	8.6671	9.5557	8.08933
11	1995	25	48.2605	61.785	42.0892	19.8144	25.4334	17.0108	8.7834	9.7717	8.16111
12	1996	26	49.3739	63.651	42.6257	20.3403	26.2306	17.2506	8.8941	9.9877	8.22776
13	1997	27	50.4656	65.518	43.1307	20.8608	27.0278	17.4772	8.9992	10.2037	8.28955
14	1998	28	51.5340	67.385	43.6054	21.3752	27.8250	17.6909	9.0990	10.4197	8.34677
15	1999	29	52.5777	69.252	44.0509	21.8824	28.6222	17.8922	9.1935	10.6357	8.39970
16	2000	30	53.5956	71.118	44.4683	22.3817	29.4194	18.0815	9.2829	10.8517	8.44861
17	2001	31	54.5864	72.985	44.8588	22.8724	30.2166	18.2592	9.3674	11.0677	8.49375
18	2002	32	55.5493	74.852	45.2237	23.3538	31.0138	18.4257	9.4471	11.2837	8.53538
19	2003	33	56.4836	76.718	45.5643	23.8252	31.8110	18.5816	9.5223	11.4997	8.57374
20	2004	34	57.3886	78.585	45.8817	24.2861	32.6082	18.7274	9.5930	11.7157	8.60906
21	2005	35	58.2640	80.452	46.1773	24.7360	33.4054	18.8636	9.6596	11.9317	8.64155
22	2006	36	59.1094	82.318	46.4523	25.1744	34.2026	18.9905	9.7222	12.1477	8.67143
23	2007	37	59.9247	84.185	46.7078	25.6010	34.9998	19.1089	9.7810	12.3637	8.69888
24	2008	38	60.7099	86.052	46.9451	26.0155	35.7970	19.2190	9.8361	12.5797	8.72410
25	2009	39	61.4650	87.919	47.1652	26.4176	36.5942	19.3215	9.8878	12.7957	8.74724
26	2010	40	62.1904	89.785	47.3693	26.8072	37.3914	19.4167	9.9363	13.0117	8.76848
27	2011	41	62.8862	91.652	47.5583	27.1841	38.1886	19.5051	9.9816	13.2277	8.78795
28	2012	42	63.5529	93.519	47.7334	27.5482	38.9858	19.5872	10.0240	13.4437	8.80580
29	2013	43	64.1911	95.385	47.8954	27.8996	39.7830	19.6633	10.0637	13.6597	8.82216
30	2014	44	64.8012	97.252	48.0452	28.2382	40.5802	19.7338	10.1007	13.8757	8.83714
31	2015	45	65.3840	99.119	48.1836	28.5641	41.3774	19.7992	10.1353	14.0917	8.85087
32	2016	46	65.9400	100.985	48.3115	28.8775	42.1746	19.8596	10.1676	14.3077	8.86343
33	2017	47	66.4699	102.852	48.4297	29.1784	42.9718	19.9156	10.1978	14.5237	8.87494
34	2018	48	66.9747	104.719	48.5387	29.4671	43.7690	19.9673	10.2259	14.7397	8.88546
35	2019	49	67.4550	106.586	48.6393	29.7438	44.5662	20.0152	10.2521	14.9557	8.89509
36	2020	50	67.9117	108.452	48.7322	30.0088	45.3634	20.0594	10.2766	15.1717	8.90390
37	2021	51	68.3455	110.319	48.8178	30.2622	46.1606	20.1002	10.2993	15.3877	8.91195

TABLE 4

ENROUTE WORKLOAD MEASURES BALANCED GROWTH 17:06 MONDAY, DECEMBER 8, 1980

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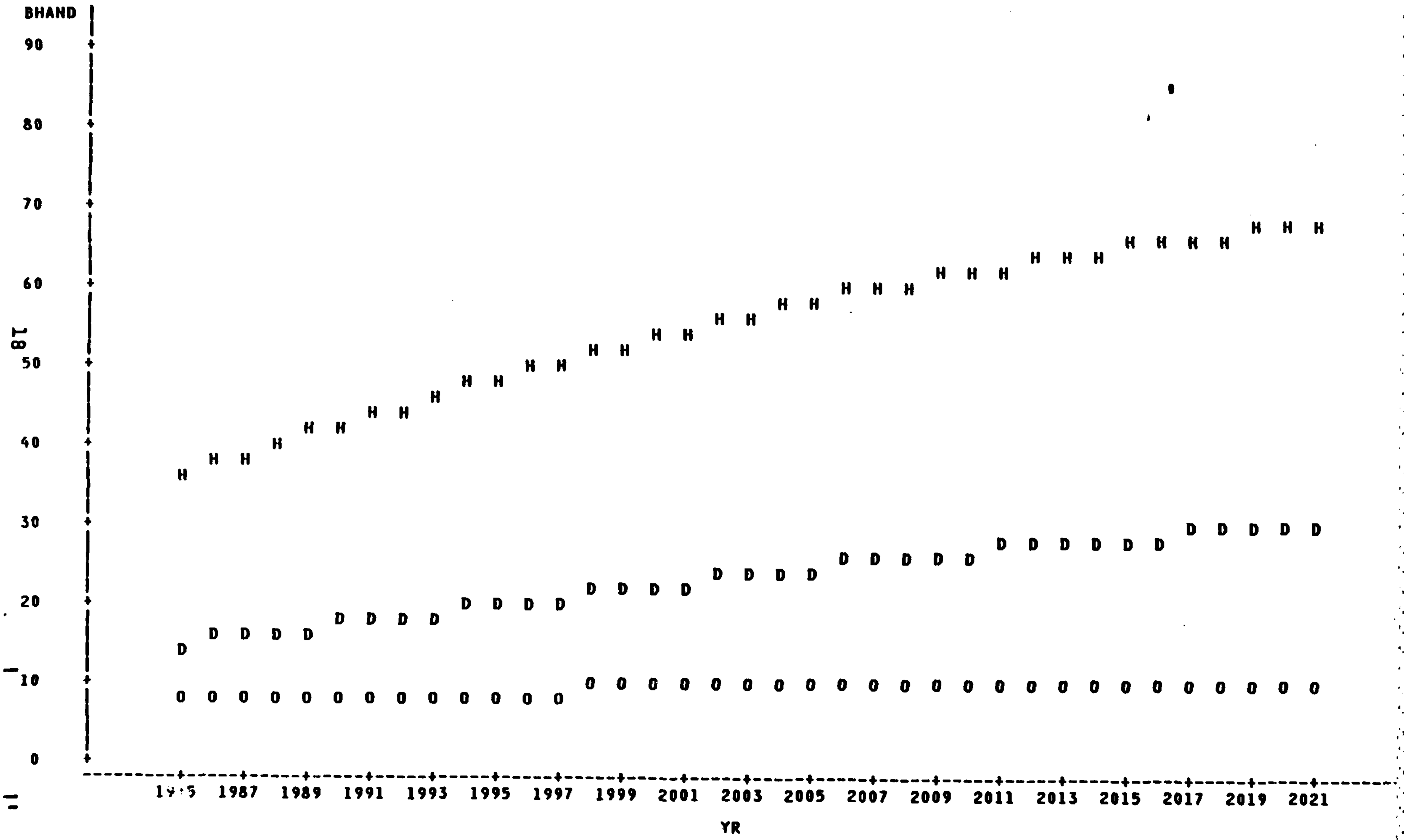

FIGURE 3

Demand on Communication Industry

The slow but steady increases observed in GNP throughout the forecast period, indicate that capital will be available for technological development in the communications industry. The net effect of increases in the demand for air transportation has special significance for the communications industry. Throughout the forecast period, aircraft operations and fleet size rise steadily which also increases the amount of air traffic. In order to efficiently handle the increased air traffic, new communications technology will have to be developed to ensure the safety of the air routes.

Rapid Growth Scenario

In the Rapid Growth Scenario it is assumed that society makes no attempt to constrain or channel economic and technological growth. National policy encourages economic and technological growth as the government acts to remove or reduce all barriers to such development.

Rapid Growth Economy

The result of rapid economic and technological growth is reflected in the GNP statistics for this scenario. Throughout the forecast period, GNP will rise at an average annual rate of 4.2%. Between 1985 and the year 2020, GNP expressed in 1972 dollars increases 342% from $1900 trillion to $8400 trillion. The average annual rate

of increase for Disposable Personal Income is approximately the same as the rate of growth in the GNP for the same forecast period. However, Disposable Personal Income (also expressed in 1972 dollars) increases 345% from 1310 trillion in 1985 to $5830 trillion in the year 2020. Civilian Employment rises steadily at an average annual rate of 1% throughout the forecast period. Between 1985 and the year 2020, the civilian workforce is projected to increase 55% from 105.7 million workers to 163.9 million workers. The values of the economic variables for each year in the 1985-2020 period are included in Table R-1.

The GNP statistics indicate that industrial production increases constantly throughout the forecast period. An increase in industrial activity indicates that there will be a great demand for general aviation transportation. The GNP measures in this forecast also indicate that substantial levels of capital will be available to develop technology in the aviation and communications industry. The projected annual rate of increase for disposable personal income and civilian employment suggest that an increasing amount of individuals will have available the resources necessary to utilize air transportation.

Aviation Industry

The size and composition of the general aviation fleet reflects society's demand for air transportation. The total general aviation fleet rises at an average annual rate of 2.4% throughout the forecast period. By the year 2020, the total general

FORECASTED RAPID GROWTH ECONOMIC VARIABLES 15:17 TUESDAY, FEBRUARY 3, 1981 5

OBS	YR	REMPLOY	RGNP	RDPI
1	1985	105.7	1900	1310
2	1986	108.3	1980	1372
3	1987	111.0	2060	1434
4	1988	113.7	2140	1496
5	1989	116.4	2220	1558
6	1990	119.0	2300	1620
7	1991	119.9	2420	1702
8	1992	120.8	2540	1784
9	1993	121.7	2660	1866
10	1994	122.6	2780	1948
11	1995	123.5	2900	2030
12	1996	124.4	3020	2112
13	1997	125.3	3140	2194
14	1998	126.2	3260	2276
15	1999	127.1	3380	2358
16	2000	128.0	3500	2440
17	2001	129.8	3700	2579
18	2002	131.6	3900	2718
19	2003	133.4	4100	2857
20	2004	135.2	4300	2996
21	2005	137.0	4500	3135
22	2006	138.8	4700	3274
23	2007	140.6	4900	3413
24	2008	142.4	5100	3552
25	2009	144.2	5300	3691
26	2010	146.0	5500	3830
27	2011	147.2	5790	4030
28	2012	148.4	6080	4230
29	2013	149.6	6370	4430
30	2014	151.7	6660	4830
31	2015	153.7	6950	4830
32	2016	155.7	7240	5030
33	2017	157.7	7530	5230
34	2018	159.7	7820	5430
35	2019	161.9	8110	5630
36	2020	163.9	8400	5830

TABLE 5

aviation fleet rises 144% from 264,975 aircraft to 645,874 aircraft. Throughout the forecast period, the number of multiengine aircraft active in the general aviation fleet increases at an average annual rate of 2.9%. Between 1985 and the year 2020, the number of multiengine aircraft active in the general aviation fleet increases 185% from 298,456 aircraft to 849,775 aircraft. The increase in multiengine aircraft activity is attributed to the increasing utilization of general aviation by private industry. Single-engine aircraft active in the general aviation fleet rises at an average annual rate of 2.4%. By the year 2020, active single-engine aircraft in the general aviation fleet increase 137% from 209,826 to 497,668 single-engine aircraft. The increase in the utilization of single-engine aircraft reflects an increase in instructional and recreational flying. The general aviation fleet mix for the Rapid Growth Scenario is shown graphically in Figure R-1. (The complete tabulation for the general aviation fleet is shown in Table B-2).

As noted previously in the Balanced Growth Scenario presentation, an increase in demand for air transportation results in an increase of FAA operational services. In the Rapid Growth Scenario, the increasing demand for air transportation further intensifies the utilization of FAA operational services. Total aircraft operations at FAA towered airports is projected to increase at an average annual rate of 2.3% throughout the forecast period.

G.A. AIRCRAFT RAPID GROWTH   11:47 MONDAY, DECEMBER 8, 1980   6

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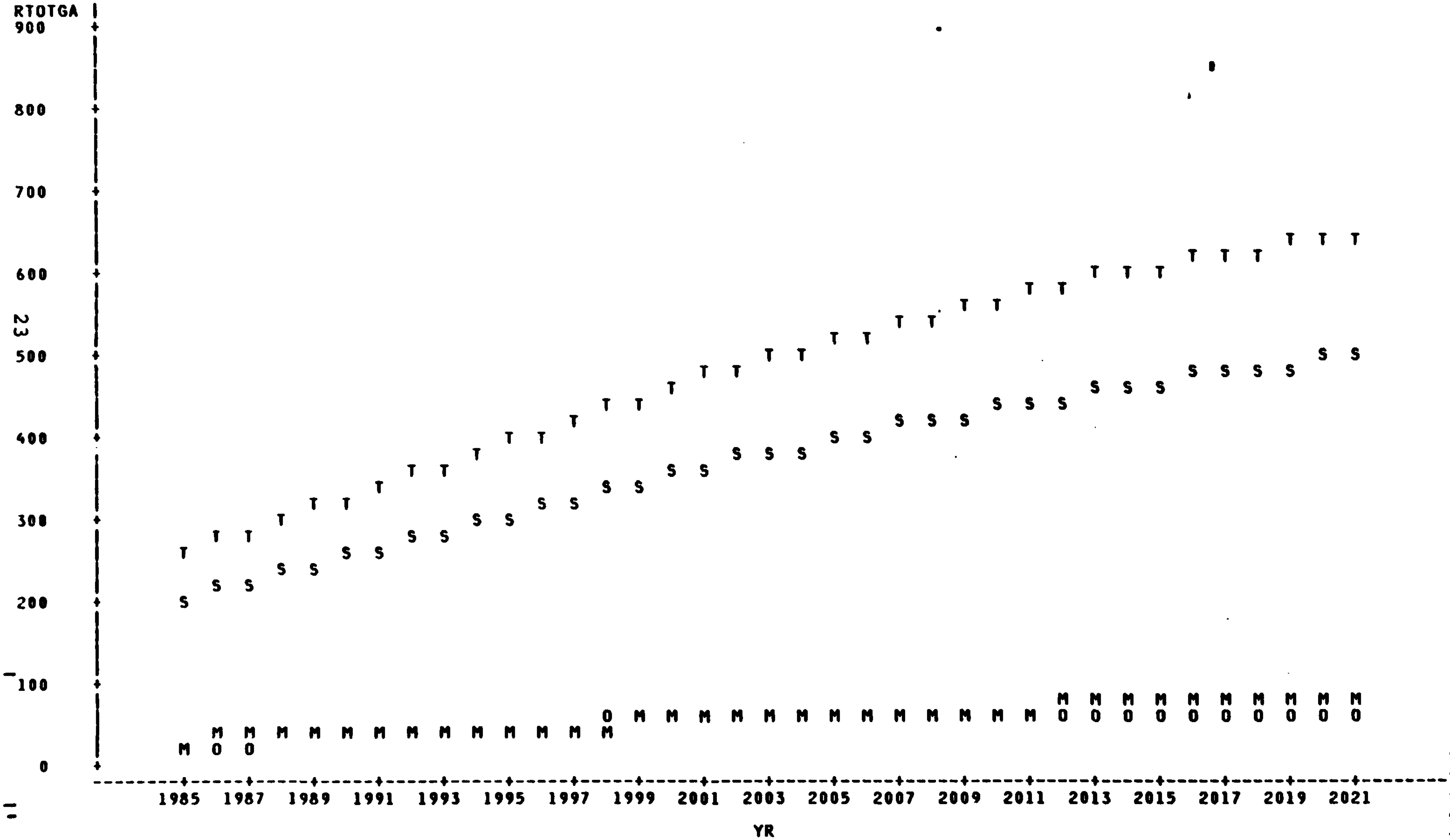

FIGURE 4

Between 1985 and the year 2020, total aircraft operations at airports with FAA towers are forecast to increase by 135% from 96 million to 226.3 million operations. Itinerant aircraft operations at FAA towered airports rises at an average annual rate of 2.5%. Between 1985 and the year 2020, itinerant aircraft operations at FAA towered airports increase 149% from 96.249 million operations to 226.299 million aircraft operations.

The increasing utilization of general aviation services by industry and the increasing demand for air carrier services by the general public will account for the increasing itinerant aircraft operations at FAA towered airports. Throughout the forecast period, local aircraft operations at FAA towered airports, increases at an average annual rate of 1.9%. By the year 2020, local aircraft operations will increase 103% beyond the 1985 figure of 28.9 million to 58.7 million local aircraft operations. The steady increase in local aircraft operations at FAA toward airports, implies that the number of pilots undergoing flight training will increase throughout the forecast period. The complete tabulations for FAA towered workload measures are given in Table B-3. Displayed graphically in Figure R-2, are the FAA towered airport workload measures for the Rapid Growth Scenario.

The growth in the number of aircraft handled by Air Route Traffic Control Centers reflects increases in general aviation traffic associated with increases in pilots capable of IFR flights. The

RAPID GROWTH OPERATIONS 21:28 SUNDAY, DECEMBER 7, 1980

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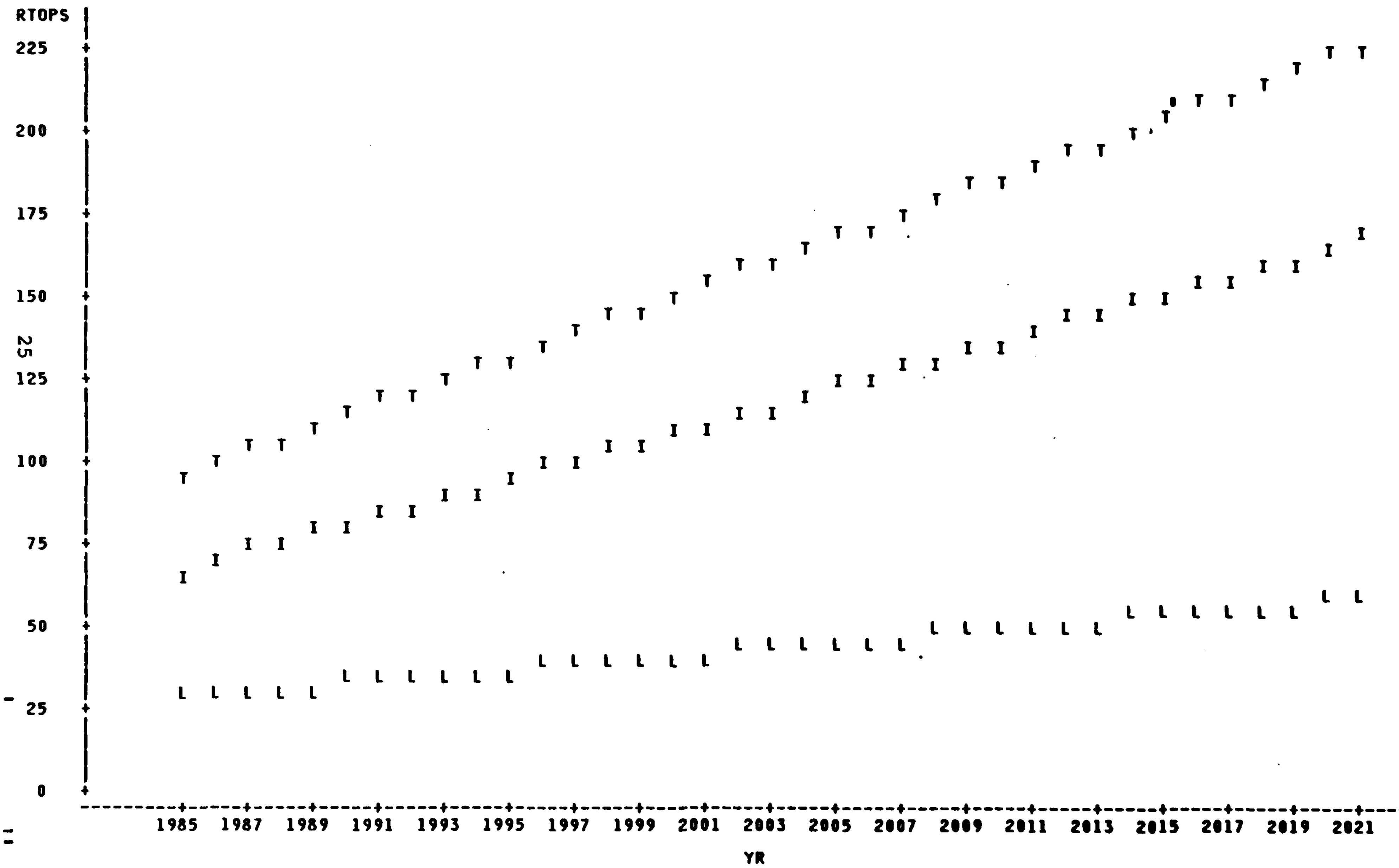

FIGURE 5

ENROUTE WORKLOAD MEASURES RAPID GROWTH 17:06 MONDAY, DECEMBER 8, 1980

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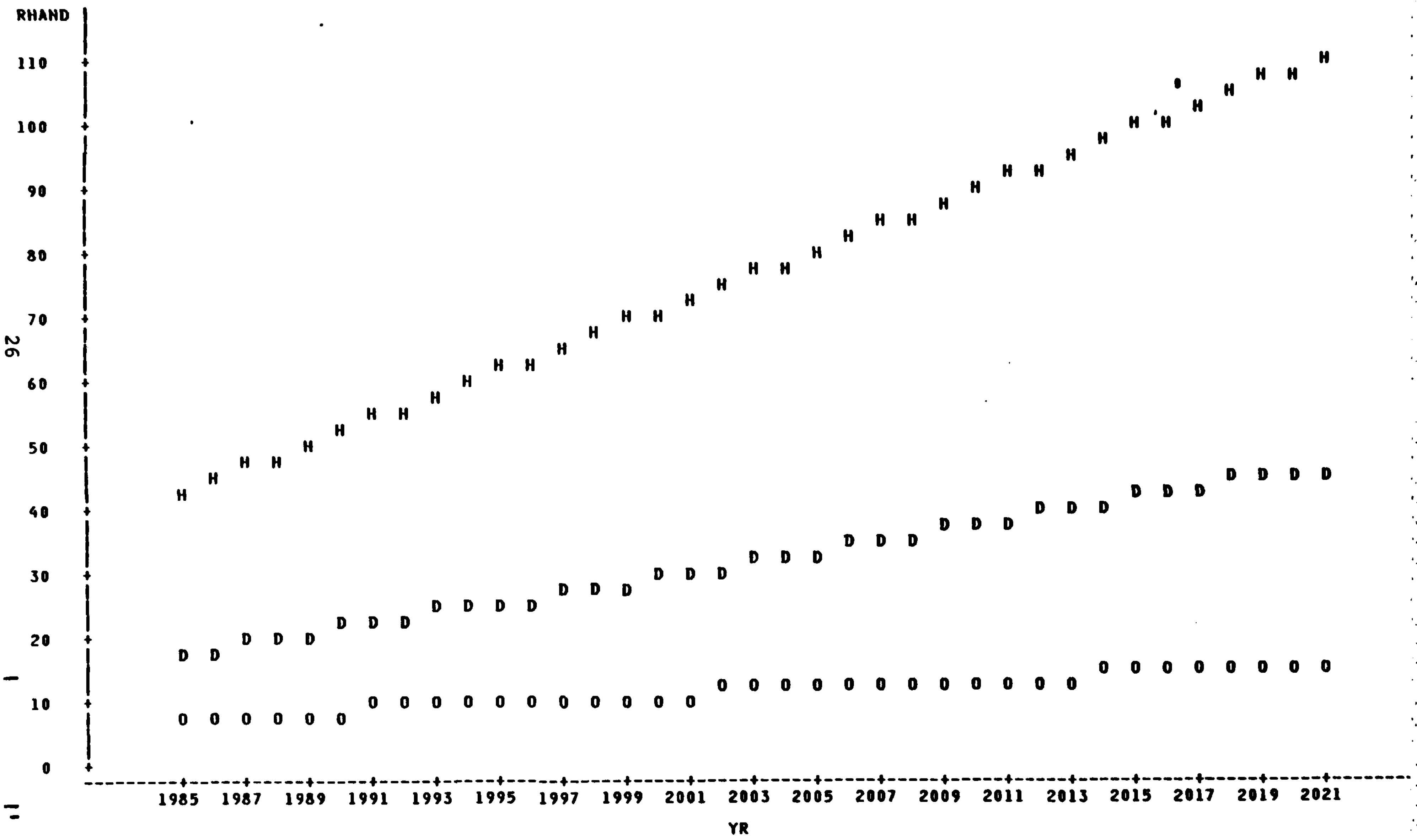

FIGURE 6

number of aircraft handled by Air Route Traffic Control Centers increases at an average annual rate of 2.6%. Between 1985 and the year 2020, IFR aircraft handled by Air Route Traffic Control Centers increases 156% from 43 million to 110.3 million aircraft. The complete tabulations of enroute work measures are given in Table B-3. Displayed graphically in Figure R-3 are the enroute measures for this scenario.

Demand in Communications Industry

As indicated by the GNP for this scenario, capital will be available for technological development in the communications industry. All measures of aviation activity confirm increases in air traffic and in turn, the need for new communications technology to direct air traffic.

Stagflation Scenario

This Stagflation Scenario is built upon the theme of acute tension between society and technology in the U.S. Government policies designed to retard technological development results in low economic growth. Poor economic conditions, in turn, impedes further technological development.

Stagflation Economy

Throughout the forecast period, GNP and Disposable Personal Income both rise at an average annual rate of 1.5%. Between 1985 and the year 2020, GNP expressed in 1972 dollars increases 68% from $1605.1 trillion to $2662.9 trillion. In the forecast period

from 1985 to 2020, Disposable Personal Income also increases 68% from $1114.6 trillion to $1876.8 trillion. During the forecast period, Civilian Employment experiences a low average annual growth rate of .48%. Between 1985 and the year 2020, Civilian Employment increases only by 19% from 103.7 million workers to 123 million workers. The tabulations of the economic variables are given in Table S-1.

The sluggish economic conditions portrayed by the variables depicted above, portend grave conseqences for the aviation and communications industries. The slow increases in GNP imply low business activity in the stagflation economy. Low business activity, in turn, suggest a decrease in general aviation transportation demanded by private industry. The minimal increases in GNP also imply that capital will not be available to advance technology in the aviation or communications industries. Due to society's negative attitude towards technological development, economic growth increases at a very low annual rate. The reduced levels of employment coupled with minimal increases in Disposable Personal Income suggest a low demand for air transportation by the general public.

Aviation Industry

The demand for general aviation transportation decreases as a result of low business production. Evidence of this phenomena is shown in the projected number of aircraft active in the general aviation fleet. The total number aircraft active in the general

OBS	YR	SEMPLOY	SGNP	SDPI
1	1985	103.7	1605.1	1114.6
2	1986	104.3	1629.2	1131.3
3	1987	105.0	1653.6	1148.3
4	1988	105.7	1678.4	1165.5
5	1989	106.4	1703.6	1183.0
6	1990	107.0	1729.2	1200.7
7	1991	107.6	1755.1	1218.7
8	1992	108.2	1781.4	1237.0
9	1993	108.8	1808.2	1255.6
10	1994	109.4	1835.3	1274.4
11	1995	110.0	1862.8	1293.5
12	1996	110.6	1890.8	1312.9
13	1997	111.2	1919.1	1332.6
14	1998	111.8	1947.9	1352.6
15	1999	112.4	1977.1	1372.9
16	2000	113.0	2006.8	1393.5
17	2001	113.5	2036.9	1414.4
18	2002	114.0	2067.4	1435.6
19	2003	114.5	2098.4	1457.1
20	2004	115.0	2129.9	1479.0
21	2005	115.5	2161.9	1501.2
22	2006	116.0	2194.3	1523.7
23	2007	116.5	2227.2	1546.5
24	2008	117.0	2260.6	1569.7
25	2009	117.5	2294.5	1593.3
26	2010	118.0	2328.9	1617.2
27	2011	118.5	2363.9	1641.4
28	2012	119.0	2399.3	1666.1
29	2013	119.5	2435.3	1691.1
30	2014	120.0	2508.9	1742.2
31	2015	120.5	2508.9	1742.2
32	2016	121.0	2546.6	1768.3
33	2017	121.5	2584.8	1794.8
34	2018	122.0	2623.5	1821.7
35	2019	122.5	2662.9	1849.1
36	2020	123.0	2702.8	1876.8

TABLE 6

aviation fleet increases at an average annual rate of .44% throughout the forecast period. Between 1985 and 2020, the total number of active aircraft in the general aviation fleet only increases 18% from 248,542 to 292,195 aircraft. The demand for multiengine aircraft by business entities accounts for most of the growth of active aircraft in the general aviation fleet.

Throughout the forecast period, the number of multiengine aircraft active in the general aviation fleet increases at an average annual rate of 1.7%. Between 1985 and the year 2020, the number of multiengine aircraft, increases 86% from 254,538 to 472,770 aircraft. The number of single-engine aircraft active in the general aviation fleet increases at an average annual rate of .4%. By the year 2020, the number of single-engine aircraft active in the general aviation fleet increases 16% from 197,622 aircraft to 229,459 aircraft. The decrease in the utilization of single-engine aircraft is attributed to the effects of low Civilian Employment levels and low Disposable Personal Income levels. As the consumer's purchasing power decreases, so will the demand for recreational and instructional flying performed in single-engine aircraft. The general aviation fleet mix for the Stagflation Scenario is shown graphically in Figure S-1. (The complete tabulation for the general aviation fleet is shown in Table B-2).

G.A. AIRCRAFT STAGFLATION   11:47 MONDAY, DECEMBER 8, 1980

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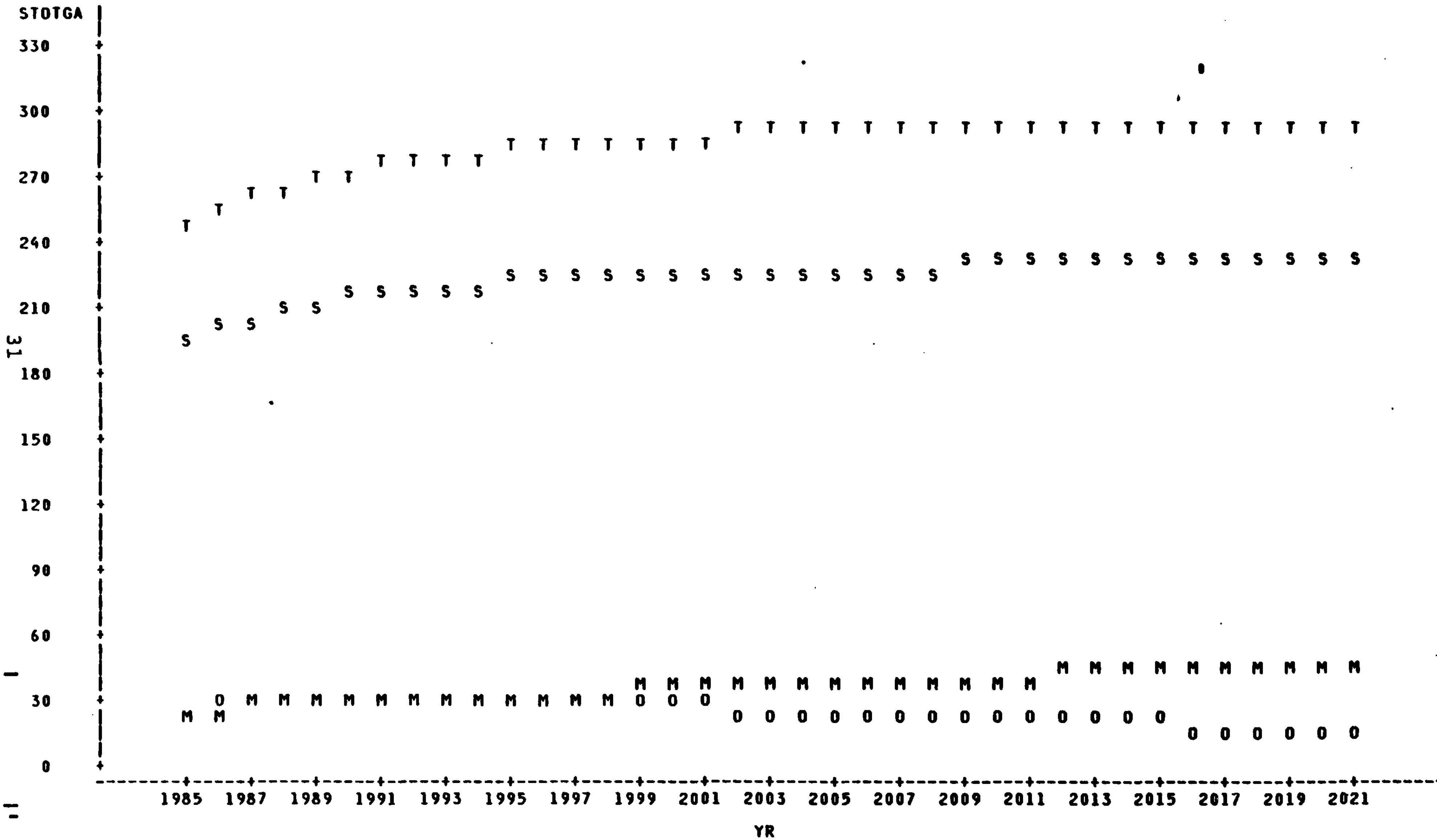

FIGURE 7

The decrease in demand for air transportation is reflected in FAA workload measures. Total aircraft operations at FAA towered airports increase at an average annual rate of .89% throughout the forecast period. By the year 2020, total aircraft operations at FAA towered airports increase 39% from 80 million aircraft operations in 1985 to 111 million operations.

Itinerant aircraft operations at FAA towered airports increase at an average annual rate of .87% throughout the forecast period. Between 1985 and the year 2020, itinerate aircraft operations at FAA towered airports increase 38% from 53 million operations to 74 million operations. The general public's inability to afford aircarrier services because of the low level of Disposal Personal Income accounts for the low annual increase in itinerant aircraft operations. Another factor that relates to the low levels of itinerant aircraft operations at FAA towered airports, is the low level of business production associated with a stagflation economy. Throughout the forecast period, local aircraft operations performed at FAA towered airports increase at an average rate of .93%. By the year 2020, local aircraft operations at FAA towered airports increase by 41% from 26 million operations in 1985 to 37 million. The low growth of local aircraft operations imply that fewer pilots will be trained during the forecast period. This phenomena further suggest a decrease in air traffic due to the decreases in the pilot population. The complete tabulations

STAGFLATION OPERATIONS   21:28 SUNDAY, DECEMBER 7, 1980

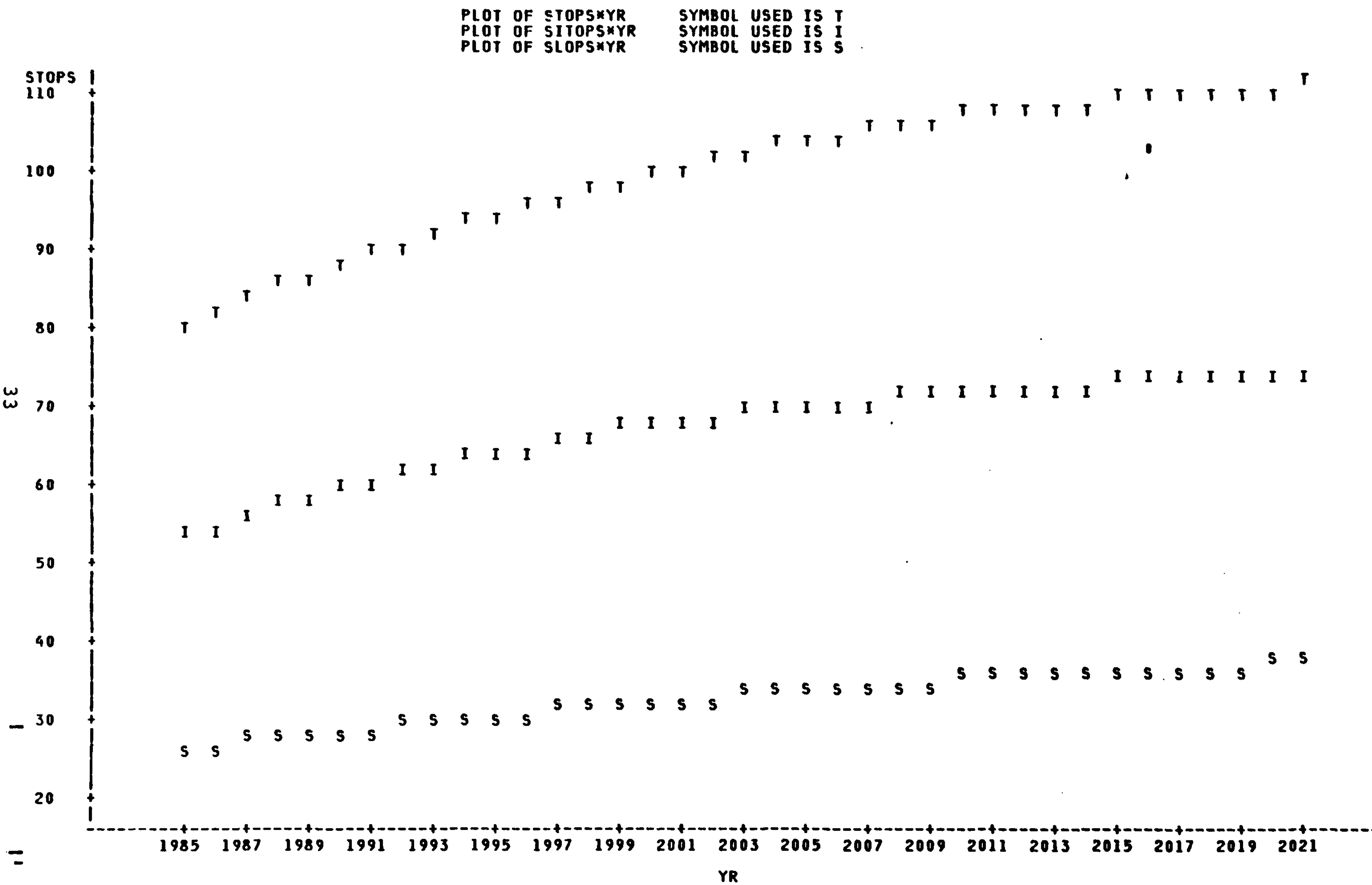

FIGURE 8

for FAA towered airport workload measures are shown in Table B-3. The measures displayed graphically in Figure S-2 are the FAA towered airport workload measures for the Stagflation Scenario.

The growth rate in the number of aircraft handled by Air Route Traffic Control Centers increases at an average annual rate of .91%. By the year 2020, the number of aircraft handled by the Air Route Traffic Control Centers increases 40% from 34.9 million aircraft in 1985 to 48.8 million aircraft. The increasingly low levels of operations at Air Route Traffic Control Centers results from decreases in general aviation traffic and the pilot population level. The complete tabulations of enroute center work measures are given in Table B-3. The enroute measures for the Stagflation Scenario are displayed graphically in Figure S-3.

Demand in Communications Industry

The reduced demand for air transportation by all segments of society will effect the aviation industry's demand for communication technology. Throughout the forecast period, aircraft operations, the pilot population and the general aviation fleet size experience very minimal growth trends, thereby reducing the need for advanced communication technology for the aviation industry.

ENROUTE WORKLOAD MEASURES STAGFLATION 17:06 MONDAY, DECEMBER 8, 1980

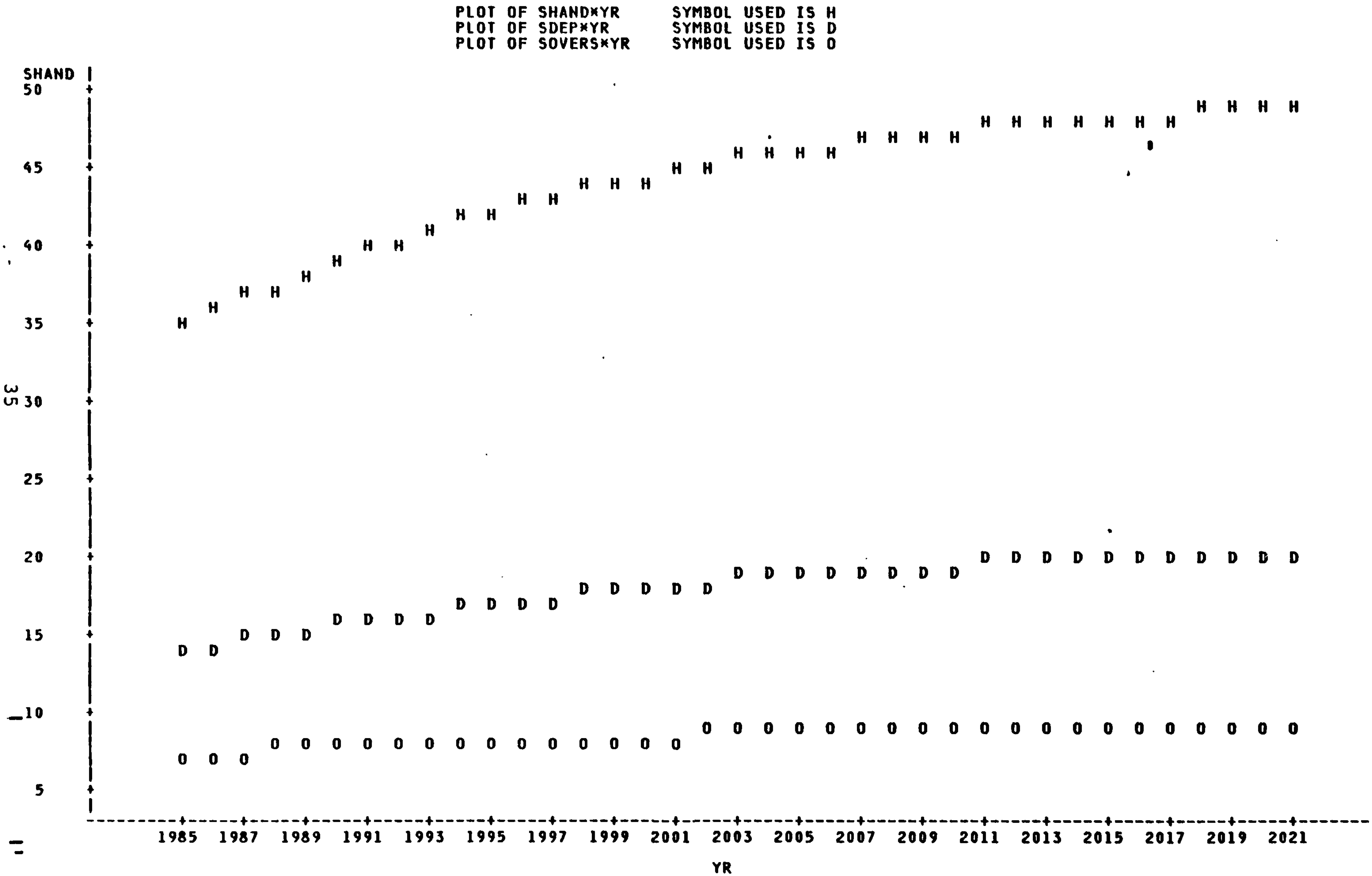

FIGURE 9

Pilot Composition

Stagflation Scenario

The decrease in aviation activity due to the levels of the economy effects the slow increase in pilot populations. Between 1995 and 2020, the total pilot population is expected to increase at an average annual rate of 1.3% and by the year 2020, the total pilot population will increase only 40% from 1.01 million pilots to 1.5 million pilots. The low levels of business activity account for the low levels of increase in private pilots who pilot general aviation aircraft. Between 1995 and 2020, the number of private pilots increases at an average annual rate of 1.2% and by the year 2020, the number of private pilots will increase 37% from 437,348 pilots to 599,215 pilots. The number of transport pilots increases at an average annual rate of 2.2% and by the year 2020, the number of transport pilots will increase 77% from 110,880 pilots to 195,948 pilots. The student pilot population will increase at an average annual rate of .97% and by the year 2020, the student pilot population is expected to increase only 29% from 242,912 to 312,202 student pilots. Table S-2 displays the pilot compositions for the Stagflation Scenario.

PILOT COMPOSITION-STAGFLATION 17:00 TUESDAY, FEBRUARY 17, 1981

OBS	YEAR	STPLT	SSTU	STRANP	SPRV
1	1995	1069.21	242.912	110.880	437.348
2	1996	1086.13	245.684	114.283	443.822
3	1997	1103.05	248.455	117.686	450.297
4	1998	1119.97	251.227	121.088	456.772
5	1999	1136.89	253.998	124.491	463.247
6	2000	1153.81	256.770	127.894	469.721
7	2001	1170.74	259.542	131.296	476.196
8	2002	1187.66	262.313	134.699	482.671
9	2003	1204.58	265.085	138.102	489.145
10	2004	1221.50	267.856	141.505	495.620
11	2005	1238.42	270.628	144.907	502.095
12	2006	1255.35	273.400	148.310	508.569
13	2007	1272.27	276.171	151.713	515.044
14	2008	1289.19	278.943	155.115	521.519
15	2009	1306.11	281.714	158.518	527.994
16	2010	1323.03	284.486	161.921	534.468
17	2011	1339.95	287.258	165.323	540.943
18	2012	1356.88	290.029	168.726	547.418
19	2013	1373.80	292.801	172.129	553.892
20	2014	1390.72	295.572	175.532	560.367
21	2015	1407.64	298.344	178.934	566.842
22	2016	1424.56	301.116	182.337	573.316
23	2017	1441.49	303.887	185.740	579.791
24	2018	1458.41	306.659	189.142	586.266
25	2019	1475.33	309.430	192.545	592.741
26	2020	1492.25	312.202	195.948	599.215
27	2021	1509.17	314.974	199.350	605.690

TABLE 7

Balanced Growth Scenario

The constant increases in the size of the general aviation fleet and the air carrier fleet connotes an increase in the pilot population. Between 1995 and 2020, the total pilot population and the number of private pilots is expected to increase at an average annual rate of 1.5%. By the year 2020, the total pilot population will increase 49% from 1.16 million pilots to 1.75 million pilots and the number of private pilots will increase 46% from 471,738 to 687,113 pilots. The increase in private pilots is associated with the increase in the size of the general aviation fleet. The increase in the number of transportation pilots reflects the increase in the utilization of air carrier service. Between 1995 and 2020, the number of transport pilots increases at an average annual rate of 2.5% and by the year 2020, the number of transport pilots will increase 88% from 128,899 pilots to 246,512 pilots. Between 1995 and 2020, the number of student pilots increases at an average annual rate of 1.2% and by the year 2020, the number of student pilots will increase 35% from 256,187 pilots to 349,847 pilots. The pilot composition for the Balanced Growth Scenario is shown in Table B-6.

OBS	YEAR	BTPLT	BSTU	BTRANP	BPRV
1	1995	1161.71	256.187	128.899	471.738
2	1996	1184.41	259.789	133.422	480.353
3	1997	1207.10	263.391	137.946	488.968
4	1998	1229.80	266.994	142.470	497.583
5	1999	1252.50	270.596	146.993	506.198
6	2000	1275.20	274.198	151.517	514.813
7	2001	1297.90	277.801	156.040	523.428
8	2002	1320.59	281.403	160.564	532.043
9	2003	1343.29	285.005	165.088	540.658
10	2004	1365.99	288.608	169.611	549.273
11	2005	1388.69	292.210	174.135	557.888
12	2006	1411.39	295.812	178.658	566.503
13	2007	1434.08	299.414	183.182	575.118
14	2008	1456.78	303.017	187.706	583.733
15	2009	1479.48	306.619	192.229	592.348
16	2010	1502.18	310.221	196.753	600.963
17	2011	1524.88	313.824	201.276	609.578
18	2012	1547.57	317.426	205.800	618.193
19	2013	1570.27	321.028	210.324	626.808
20	2014	1592.97	324.631	214.847	635.423
21	2015	1615.67	328.233	219.371	644.038
22	2016	1638.36	331.835	223.894	652.653
23	2017	1661.06	335.437	228.418	661.268
24	2018	1683.76	339.040	232.942	669.883
25	2019	1706.46	342.642	237.465	678.498
26	2020	1729.16	346.244	241.989	687.113
27	2021	1751.85	349.847	246.512	695.728

TABLE 8

Rapid Growth Scenario

The increase in aviational activity gives rise to the increase in the pilot population. The total pilot population increases at an average annual rate of 2.1% between 1995 and 2020 and by the year 2020, the total pilot population will increase 72% from 1.48 million to 2.55 million pilots. The number of private pilots increases at an average annual rate of 2% and the number of private pilots is expected to increase 67% from 586,877 pilots to 978,777 pilots. The continuing demand for air carrier service is reflected in the increase of transport pilots. The number of transport pilots increases at an average annual rate of 2.9% and by the year 2020, the number of transport pilots will increase 109% from 189,194 to 594,739 pilots. The number of student pilots increases at an average annual rate of 1.7% and by 2020, the number of student pilots is expected to increase 55% from 309,098 pilots to 480,470 student pilots. The pilot composition for the Rapid Growth Scenario is presented in Table R-2.

OBS	YEAR	RTPLT	RSTU	RTRANP	RPRV
1	1995	1485.53	309.098	189.194	586.877
2	1996	1528.13	315.953	197.416	602.553
3	1997	1570.74	322.808	205.638	618.229
4	1998	1613.35	329.663	213.860	633.905
5	1999	1655.95	336.518	222.082	649.581
6	2000	1698.56	343.372	230.303	665.257
7	2001	1741.17	350.227	238.525	680.933
8	2002	1783.77	357.082	246.747	696.609
9	2003	1826.38	363.937	254.969	712.285
10	2004	1868.99	370.792	263.191	727.961
11	2005	1911.59	377.647	271.412	743.637
12	2006	1954.20	384.502	279.634	759.313
13	2007	1996.81	391.357	287.856	774.989
14	2008	2039.41	398.212	296.078	790.665
15	2009	2082.02	405.067	304.300	806.341
16	2010	2124.63	411.921	312.521	822.017
17	2011	2167.23	418.776	320.743	837.693
18	2012	2209.84	425.631	328.965	853.369
19	2013	2252.45	432.486	337.187	869.045
20	2014	2295.05	439.341	345.409	884.721
21	2015	2337.66	446.196	353.630	900.397
22	2016	2380.27	453.051	361.852	916.073
23	2017	2422.87	459.906	370.074	931.749
24	2018	2465.48	466.761	378.296	947.425
25	2019	2508.09	473.616	386.518	963.101
26	2020	2550.69	480.470	394.739	978.777
27	2021	2593.30	487.325	402.961	994.453

TABLE 9

Air Carrier Fleet

Balanced Growth Scenario

An increase in disposable personal income and civilian employment suggest that more of the public will become involved in travelling. Between 1985 and the year 2020, the air carrier fleet is expected to increase concurrently with the steady growth in the general economy. The air carrier fleet increases at an average annual rate of 1.1% between 1995 and 2020 and by the year 2020 the air carrier fleet will increase 34% from 3338 aircraft to 4488 aircraft. (See Table B-5 for complete tabulation of air carrier fleet).

Rapid Growth Scenario

The steady increase in the level of the general economy places further demands on air carrier service. The effects of this demand is evidenced in the number of aircraft that comprise the air carrier fleet. Between 1995 and the year 2020, the air carrier fleet increases at an average annual rate of 1.8% and by the year 2020 the air carrier fleet will increase 58% from 4288 aircraft to 6759 aircraft. (Refer to Table B-5 for tabulation of air carrier fleet for this scenario).

Stagflation Scenario

Between 1995 and the year 2020, the air carrier fleet decreases at an average annual rate of .6% and by the year 2020 the air carrier fleet will decrease 13% from 2381 aircraft to 2063 aircraft.

Factors influencing the decrease in demand for air carrier service include the low levels of disposable income and civilian employment associated with a Stagflation economy. The economic variables indicate that the public's desire to travel will be curtailed because of inflationary prices and the low levels of increase in consumer purchasing power. (Refer to Table B-5 for tabulations of air carrier fleet).

AIRCARRIER FLEET-ALL SCENARIOS 17:22 TUESDAY, FEBRUARY 17, 1981

OBS	YEAR	STAC	BTAC	RTAC
1	1995	2380.80	3338.20	4288.29
2	1996	2368.09	3382.42	4387.12
3	1997	2355.38	3426.64	4485.95
4	1998	2342.67	3470.86	4584.78
5	1999	2329.96	3515.08	4683.60
6	2000	2317.25	3559.30	4782.43
7	2001	2304.54	3603.52	4881.26
8	2002	2291.83	3647.74	4980.09
9	2003	2279.12	3691.96	5078.91
10	2004	2266.41	3736.18	5177.74
11	2005	2253.70	3780.40	5276.57
12	2006	2240.99	3824.62	5375.40
13	2007	2228.28	3868.85	5474.23
14	2008	2215.57	3913.07	5573.05
15	2009	2202.86	3957.29	5671.88
16	2010	2190.15	4001.51	5770.71
17	2011	2177.44	4045.73	5869.54
18	2012	2164.73	4089.95	5968.36
19	2013	2152.02	4134.17	6067.19
20	2014	2139.31	4178.39	6166.02
21	2015	2126.60	4222.61	6264.85
22	2016	2113.89	4266.83	6363.67
23	2017	2101.18	4311.05	6462.50
24	2018	2088.47	4355.27	6561.33
25	2019	2075.76	4399.50	6660.16
26	2020	2063.05	4443.72	6758.98
27	2021	2050.34	4487.94	6857.81

TABLE 10

Summary

Each scenario in this report has been constructed in an internally consistent manner allowing for comparative analysis. In each scenario, society's differing attitudes toward technological development are reflected in the economic variables projected for each scenario. A graph for each economic variable is shown in Figures C-1, C-2, and C-3. The charts depict the growth trend corresponding to each alternative scenario. The same information is supplied in tabular form in Tables C-1, C-2, and C-3. The future for a society which chooses not to constrain technological development is illustrated in the growth trends represented by the Rapid Growth Scenario. On the contrary, national policy which dictates the rate and direction of economic and technological development, results in an economy with a low or a moderate growth rate. This phenomena is illustrated in the growth trends represented by the Balanced Growth Scenario and Stagflation Scenario.

The level of industrial activity in each scenario directly affects the demand for general aviation transportation. Graphs of the number of component aircraft types that comprise the general aviation fleet are shown in Figures C-4, C-5, and C-6. The growth rates in the utilization of the aircraft for each scenario are also depicted in the figures. The rise in the level of industrial activity associated with the Rapid Growth Scenario

FORECASTED GNP ALL SCENARIOS 15:46 TUESDAY, FEBRUARY 3, 1981

PLOT OF BGNP*YR   SYMBOL USED IS B
PLOT OF RGNP*YR   SYMBOL USED IS R
PLOT OF SGNP*YR   SYMBOL USED IS S

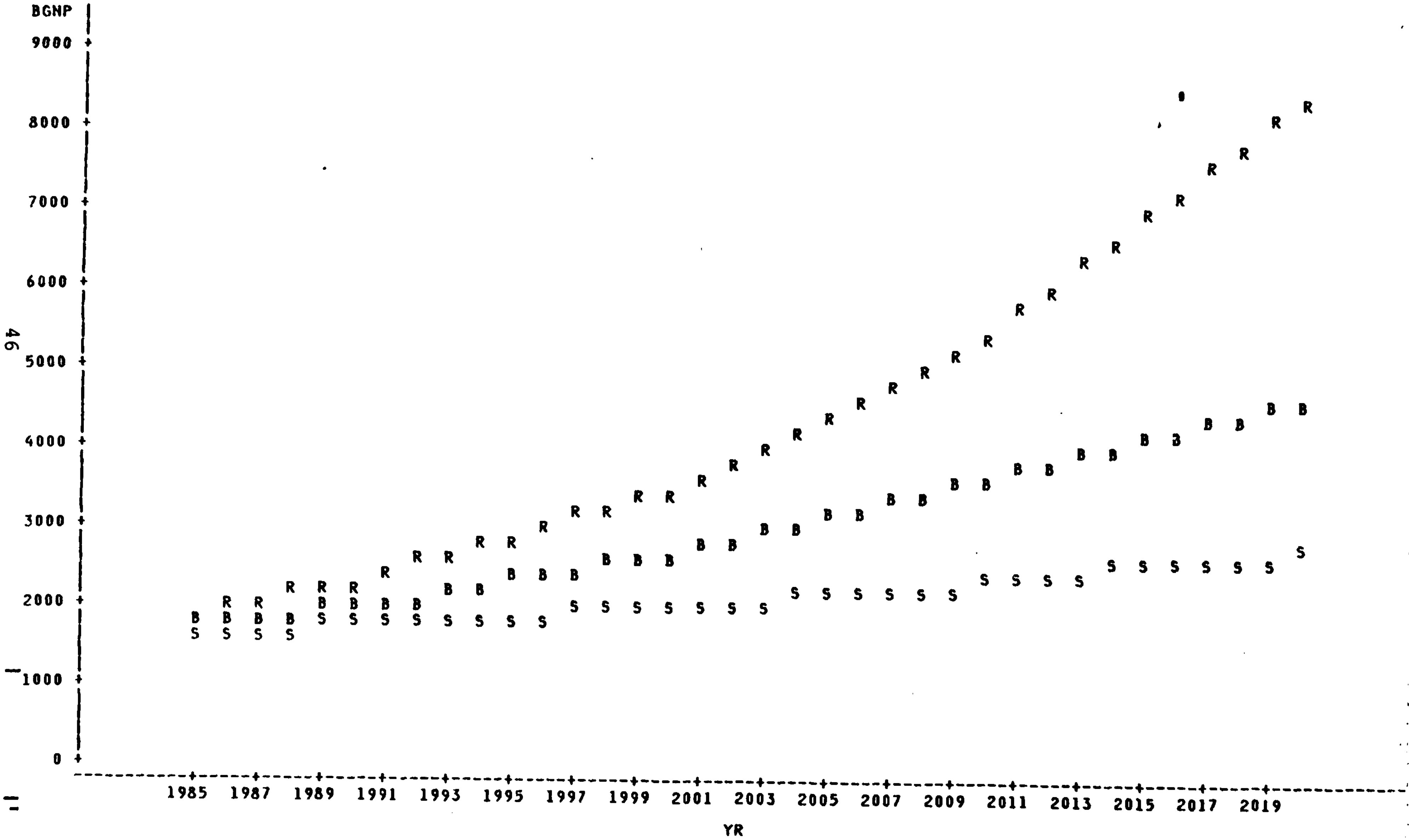

FIGURE 10

FORECASTED DPI ALL SCENARIOS 15:46 TUESDAY, FEBRUARY 3, 1981

PLOT OF BDPI*YR SYMBOL USED IS B
PLOT OF RDPI*YR SYMBOL USED IS R
PLOT OF SDPI*YR SYMBOL USED IS S

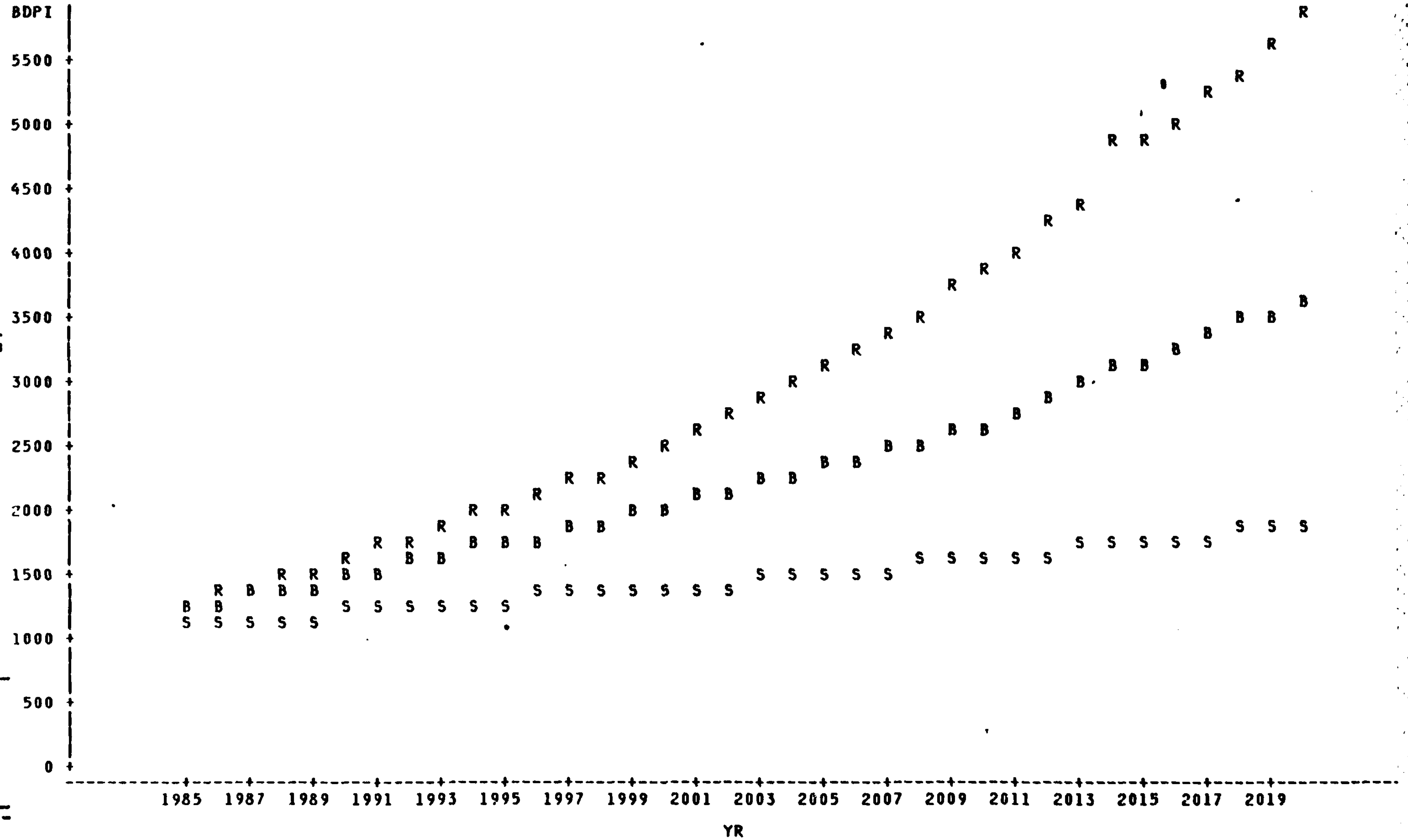

FIGURE 11

EMPLOYMENT FORECAST-ALL SCENARIOS

PLOT OF BEMPLOY*YR   SYMBOL USED IS B
PLOT OF REMPLOY*YR   SYMBOL USED IS R
PLOT OF SEMPLOY*YR   SYMBOL USED IS S

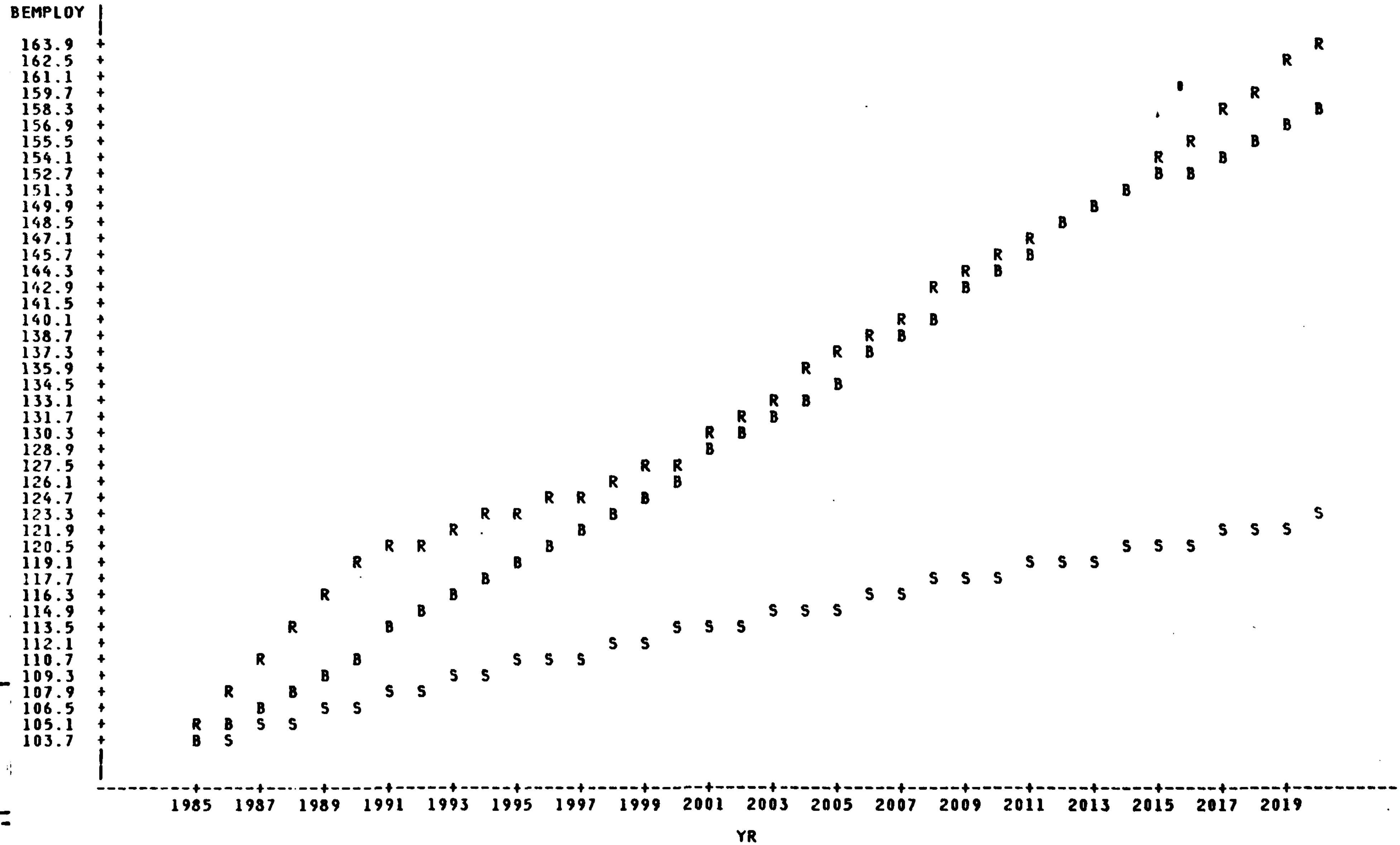

FIGURE 12

OBS	YR	BGNP	RGNP	SGNP
1	1985	1740	1900	1605.1
2	1986	1782	1980	1629.2
3	1987	1822	2060	1653.6
4	1988	1862	2140	1678.4
5	1989	1902	2220	1703.6
6	1990	1950	2300	1729.2
7	1991	2025	2420	1755.1
8	1992	2100	2540	1781.4
9	1993	2175	2660	1808.2
10	1994	2250	2780	1835.3
11	1995	2325	2900	1862.8
12	1996	2400	3020	1890.8
13	1997	2475	3140	1919.1
14	1998	2550	3260	1947.9
15	1999	2625	3380	1977.1
16	2000	2700	3500	2006.8
17	2001	2790	3700	2036.9
18	2002	2880	3900	2067.4
19	2003	2970	4100	2098.4
20	2004	3060	4300	2129.9
21	2005	3150	4500	2161.9
22	2006	3240	4700	2194.3
23	2007	3330	4900	2227.2
24	2008	3420	5100	2260.6
25	2009	3510	5300	2294.5
26	2010	3600	5500	2328.9
27	2011	3710	5790	2363.9
28	2012	3820	6080	2399.3
29	2013	3930	6370	2435.3
30	2014	4040	6660	2508.9
31	2015	4150	6950	2508.9
32	2016	4260	7240	2546.6
33	2017	4370	7530	2584.8
34	2018	4480	7820	2623.5
35	2019	4590	8110	2662.9
36	2020	4700	8400	2702.8

TABLE 11

OBS	YR	BDPI	RDPI	SDPI
1	1985	1250	1310	1114.6
2	1986	1296	1372	1131.3
3	1987	1342	1434	1148.3
4	1988	1388	1496	1165.5
5	1989	1434	1558	1183.0
6	1990	1480	1620	1200.7
7	1991	1532	1702	1218.7
8	1992	1584	1784	1237.0
9	1993	1636	1866	1255.6
10	1994	1688	1948	1274.4
11	1995	1740	2030	1293.5
12	1996	1792	2112	1312.9
13	1997	1844	2194	1332.6
14	1998	1896	2276	1352.6
15	1999	1948	2358	1372.9
16	2000	2000	2440	1393.5
17	2001	2067	2579	1414.4
18	2002	2134	2718	1435.6
19	2003	2201	2857	1457.1
20	2004	2268	2996	1479.0
21	2005	2335	3135	1501.2
22	2006	2402	3274	1523.7
23	2007	2469	3413	1546.5
24	2008	2536	3552	1569.7
25	2009	2603	3691	1593.3
26	2010	2670	3830	1617.2
27	2011	2767	4030	1641.4
28	2012	2867	4230	1666.1
29	2013	2961	4430	1691.1
30	2014	3155	4830	1742.2
31	2015	3155	4830	1742.2
32	2016	3252	5030	1768.3
33	2017	3349	5230	1794.8
34	2018	3446	5430	1821.7
35	2019	3543	5630	1849.1
36	2020	3640	5830	1876.8

TABLE 12

FORECASTED EMPLOYMENT-MILLIONS 15:17 TUESDAY, FEBRUARY 3, 1981 1

OBS	YR	BEMPLOY	REMPLOY	SEMPLOY
1	1985	104.3	105.7	103.7
2	1986	105.7	108.3	104.3
3	1987	107.1	111.0	105.0
4	1988	108.5	113.7	105.7
5	1989	109.9	116.4	106.4
6	1990	111.3	119.0	107.0
7	1991	112.8	119.9	107.6
8	1992	114.2	120.8	108.2
9	1993	115.7	121.7	108.8
10	1994	117.2	122.6	109.4
11	1995	118.7	123.5	110.0
12	1996	120.3	124.4	110.6
13	1997	121.8	125.3	111.2
14	1998	123.4	126.2	111.8
15	1999	125.0	127.1	112.4
16	2000	126.6	128.0	113.0
17	2001	128.3	129.8	113.5
18	2002	129.9	131.6	114.0
19	2003	131.6	133.4	114.5
20	2004	133.4	135.2	115.0
21	2005	135.1	137.0	115.5
22	2006	136.8	138.8	116.0
23	2007	138.6	140.6	116.5
24	2008	140.4	142.4	117.0
25	2009	142.3	144.2	117.5
26	2010	144.1	146.0	118.0
27	2011	145.9	147.2	118.5
28	2012	147.8	148.4	119.0
29	2013	149.8	149.6	119.5
30	2014	150.8	151.7	120.0
31	2015	152.0	153.7	120.5
32	2016	153.2	155.7	121.0
33	2017	154.4	157.7	121.5
34	2018	155.6	159.7	122.0
35	2019	156.8	161.9	122.5
36	2020	158.0	163.9	123.0

TABLE 13

TOTAL GA AIRCRAFT BY SCENARIO 11:47 MONDAY, DECEMBER 8, 1980

PLOT OF BTOTGA*YR SYMBOL USED IS B
PLOT OF RTOTGA*YR SYMBOL USED IS R
PLOT OF STOTGA*YR SYMBOL USED IS S

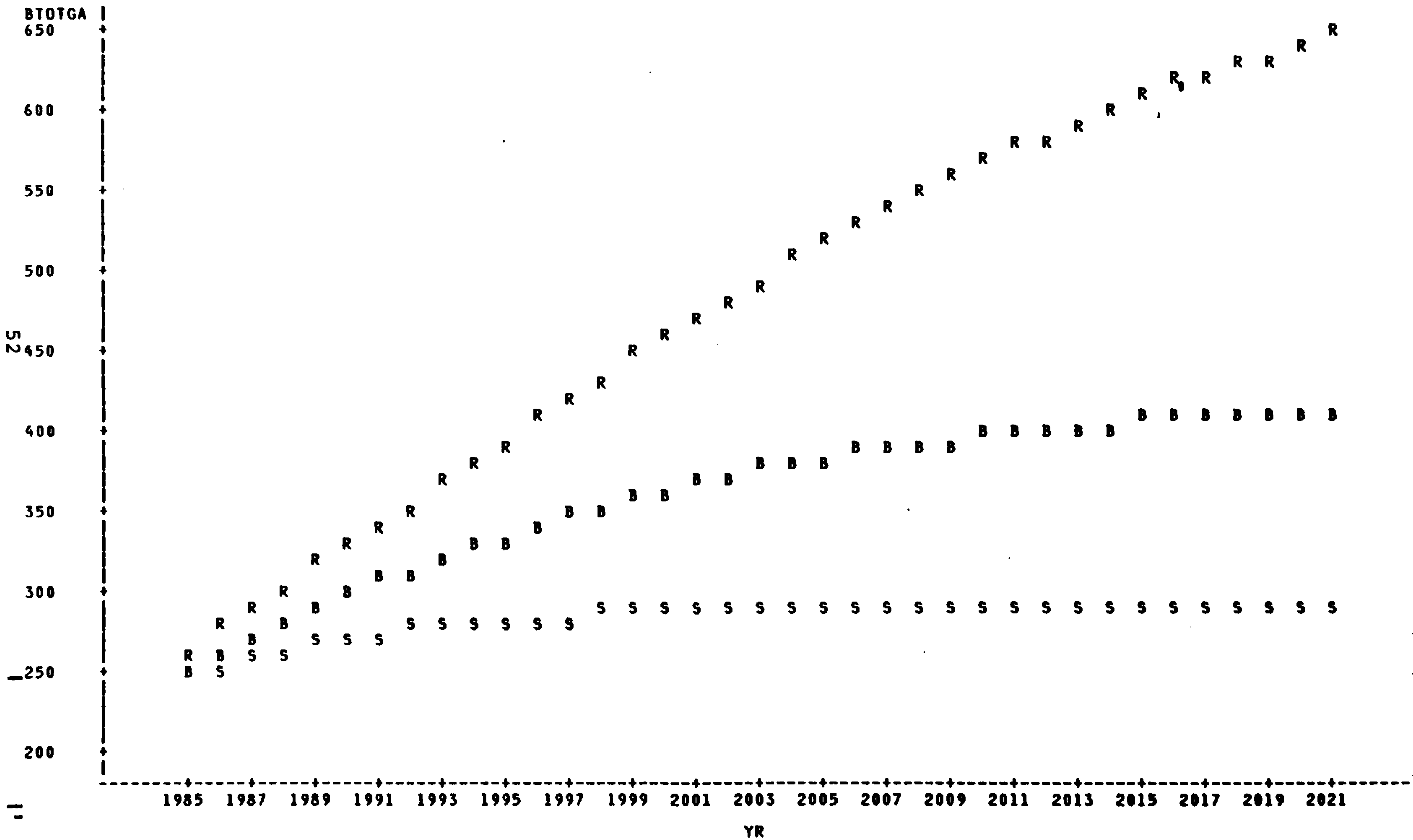

FIGURE 13

MULIT-ENGINE A.C. BY SCENARIO

11:47 MONDAY, DECEMBER 8, 1980 4

PLOT OF BMEGA*YR SYMBOL USED IS B
PLOT OF RMEGA*YR SYMBOL USED IS R
PLOT OF SMEGA*YR SYMBOL USED IS S

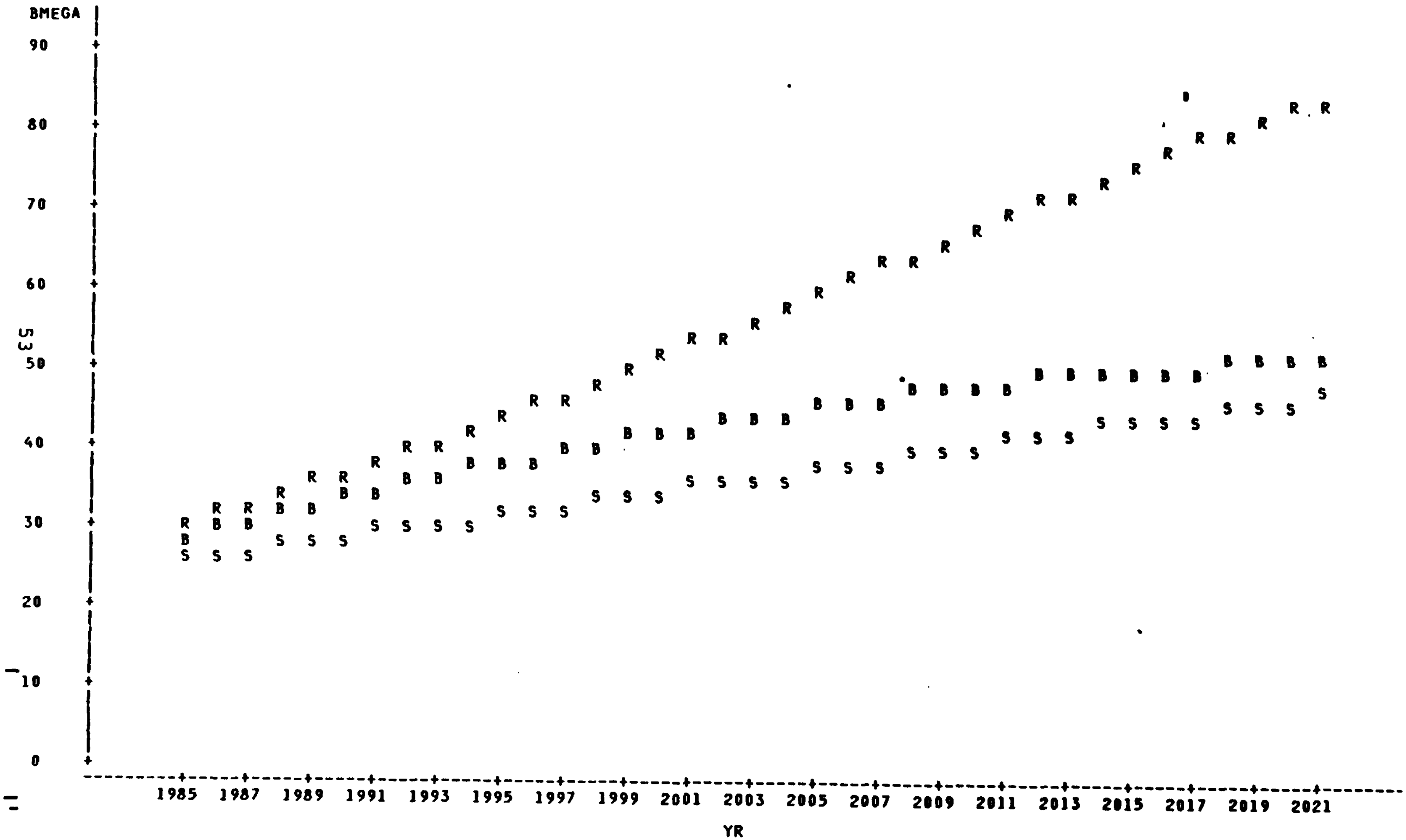

FIGURE 14

SINGLE ENGINE A.C. BY SCENARIO 11:47 MONDAY, DECEMBER 8, 1980 3

PLOT OF BSEGA*YR SYMBOL USED IS B
PLOT OF RSEGA*YR SYMBOL USED IS R
PLOT OF SSEGA*YR SYMBOL USED IS S

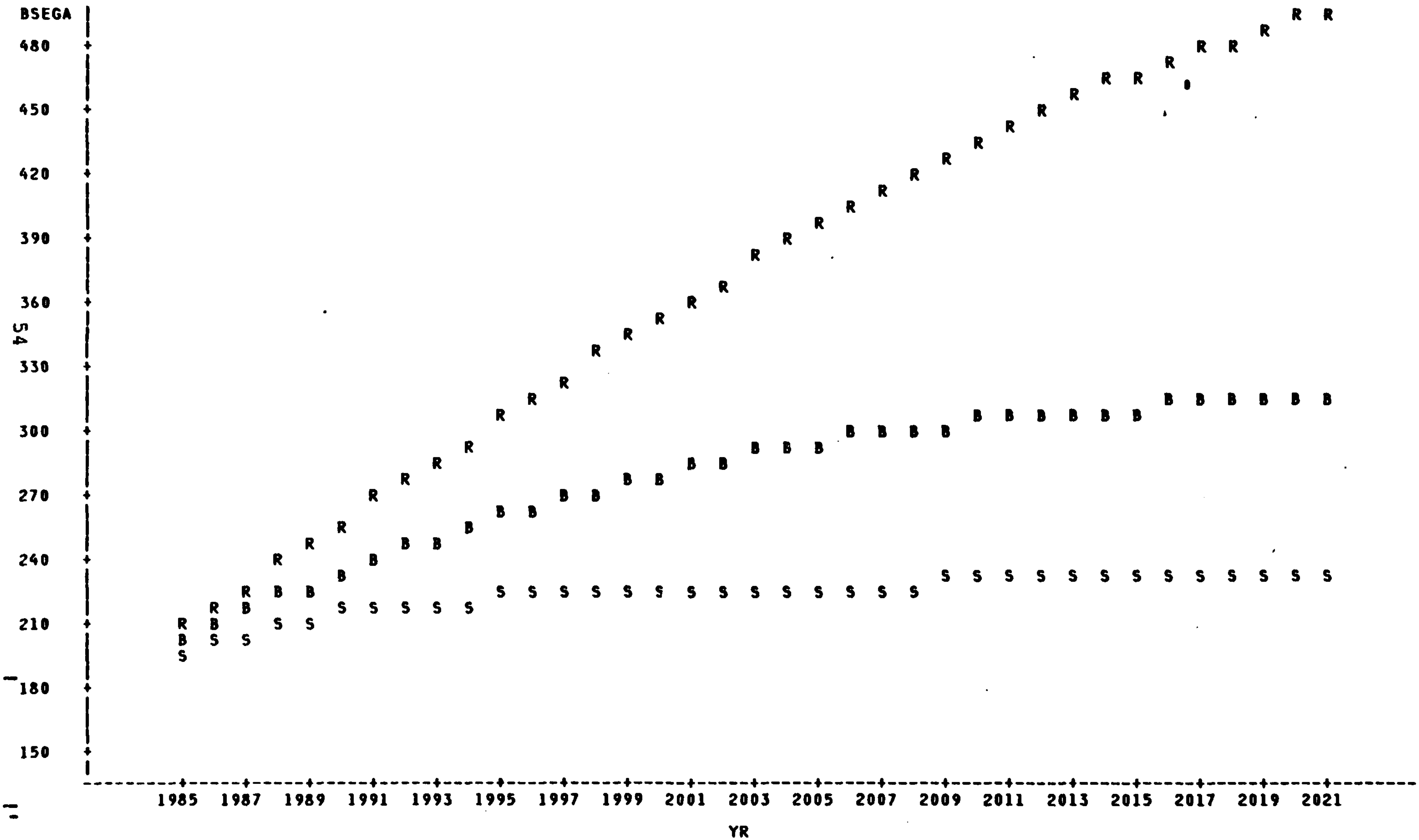

FIGURE 15

accounts for the increased utilization of the general aviation fleet for that scenario. As a result of the low levels of industrial activity associated with the Stagflation Scenario, the graphs exhibit a low growth rate for the utilization of the general aviation fleet in that scenario.

It has been demonstrated that FAA workload measures reflect growth in the aviation activity. A graph for each aircraft operation performed by the FAA at the FAA towered airports is shown in Figures C-7, C-8, C-9. The charts depict growth trends corresponding to each scenario. As indicated previously, the demand for air transportation by industry and the general public affect the level of aircraft operations at FAA towered airports. Specifically, local aircraft operations also indicate the number of pilots undergoing flight instruction. The effects of a rapidly expanding economy versus a moderate and low growth economy is reflected in the graph for each type of aircraft operations at FAA towered aircraft operation airports.

The level of operations at Air Route Traffic Control Centers is a function of the level of general aviation traffic, the type of aircraft in the general aviation fleet, and the number of pilots capable of conducting IFR flights. A graph for each enroute center workload measure is shown in Figures C-10, C-11, and C-12. The number of aircraft operations generated by each scenario are also displayed graphically. An increase in business activity,

TOTAL OPERATIONS BY SCENARIO 21:28 SUNDAY, DECEMBER 7, 1980

PLOT OF BTOPS*YR SYMBOL USED IS B
PLOT OF RTOPS*YR SYMBOL USED IS R
PLOT OF STOPS*YR SYMBOL USED IS S

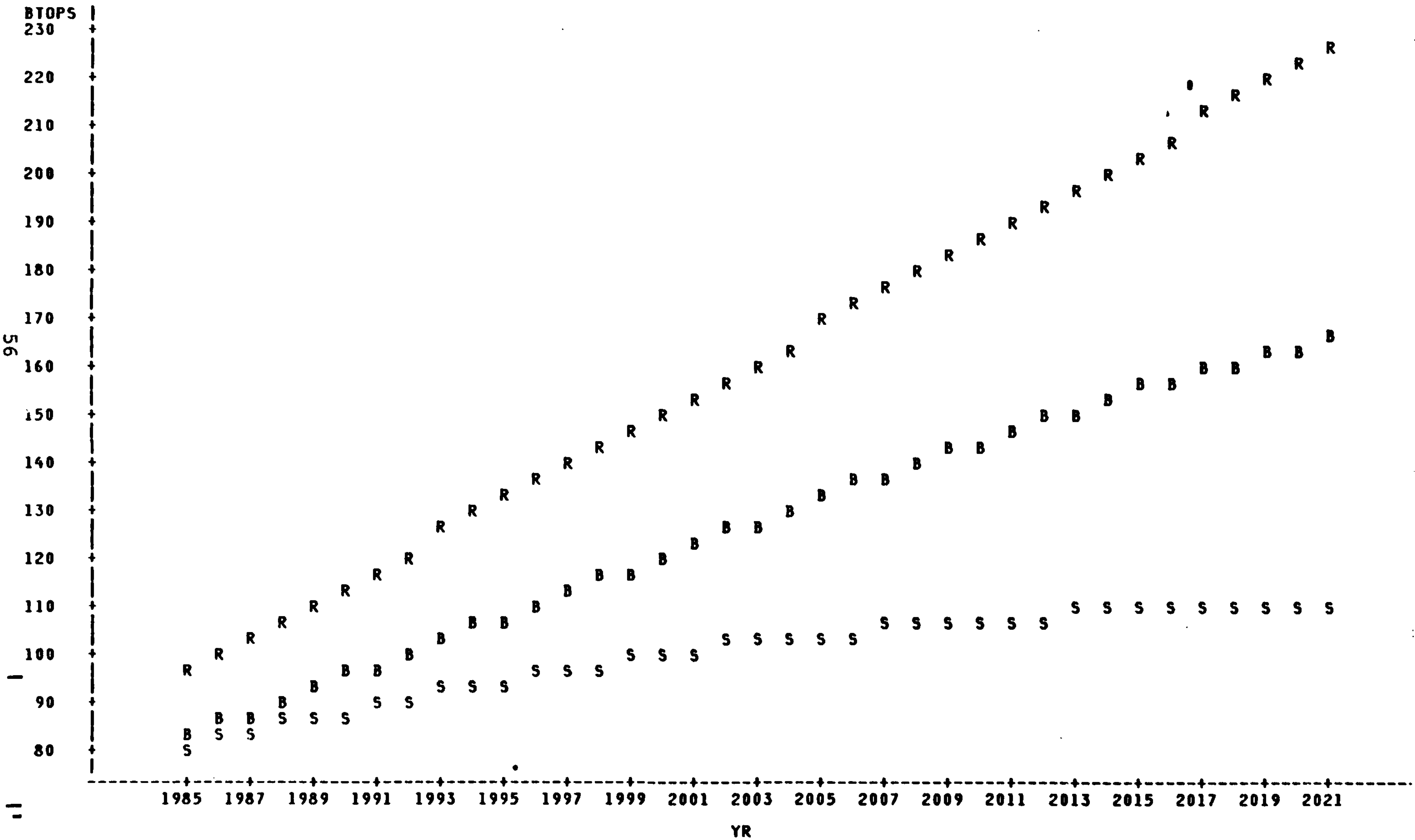

FIGURE 16

ITINERANT OPERATIONS BY SCENARIO   21:28 SUNDAY, DECEMBER 7, 1980

PLOT OF BITOPS*YR   SYMBOL USED IS B
PLOT OF RITOPS*YR   SYMBOL USED IS R
PLOT OF SITOPS*YR   SYMBOL USED IS S

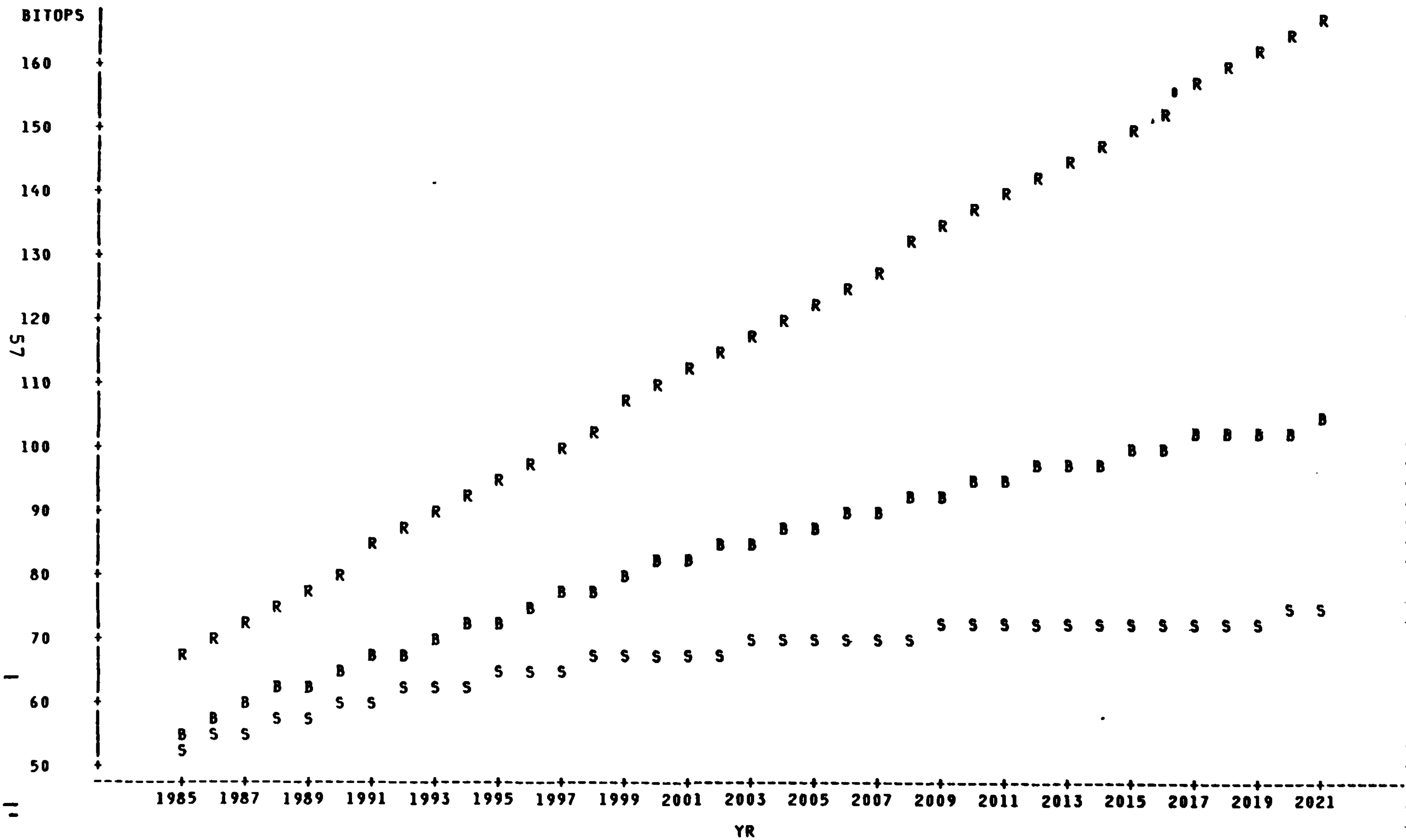

FIGURE 17

LOCAL OPERATIONS BY SCENARIO 21:28 SUNDAY, DECEMBER 7, 1980

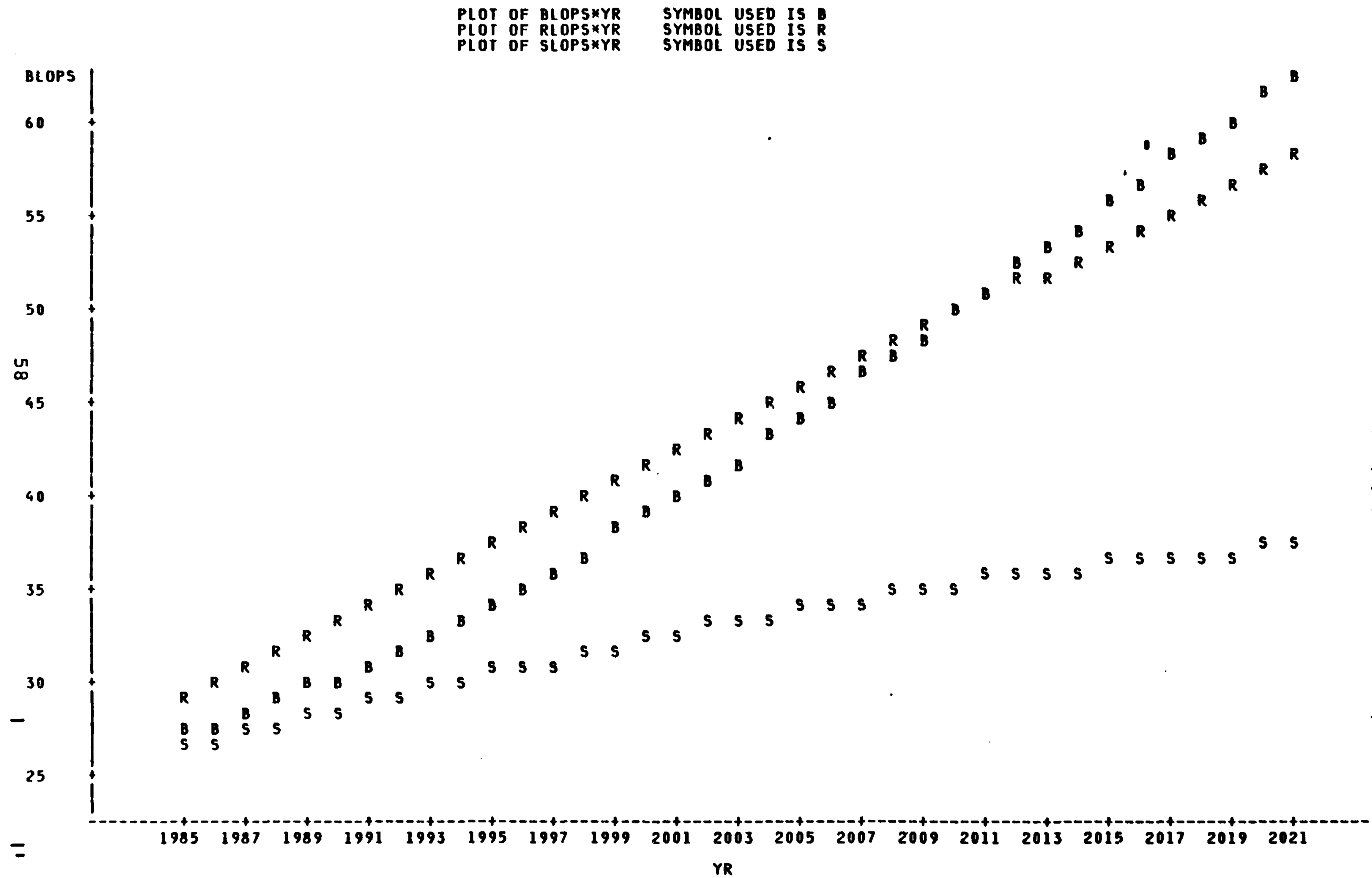

FIGURE 18

TOTAL AIRCRAFT HANDLED BY SCENARIO 17:06 MONDAY, DECEMBER 8, 1980

PLOT OF BHAND*YR SYMBOL USED IS B
PLOT OF RHAND*YR SYMBOL USED IS R
PLOT OF SHAND*YR SYMBOL USED IS S

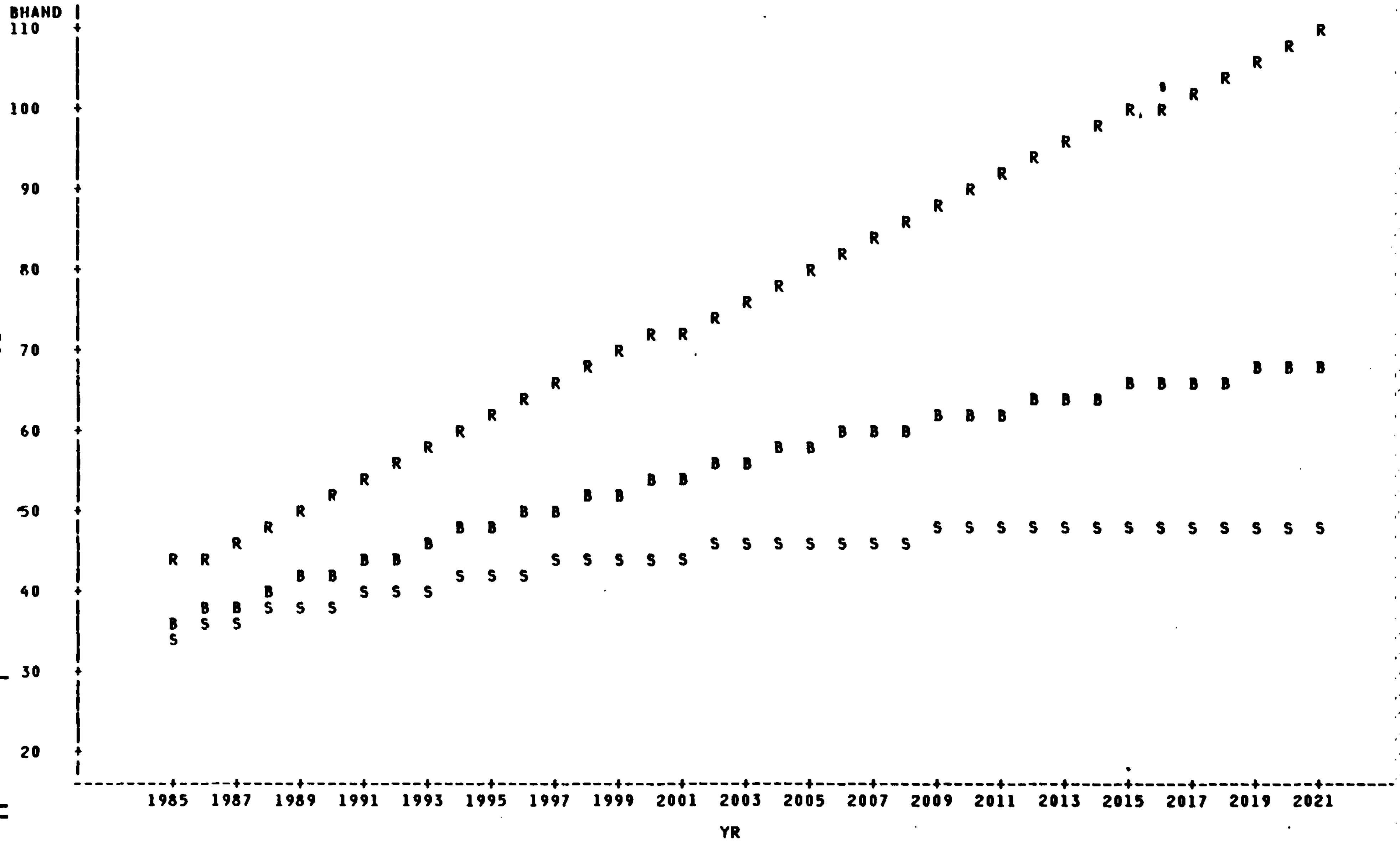

FIGURE 19

TOTAL IFR DEPARTURES BY SCENARIO

PLOT OF BDEP*YR SYMBOL USED IS B
PLOT OF RDEP*YR SYMBOL USED IS R
PLOT OF SDEP*YR SYMBOL USED IS S

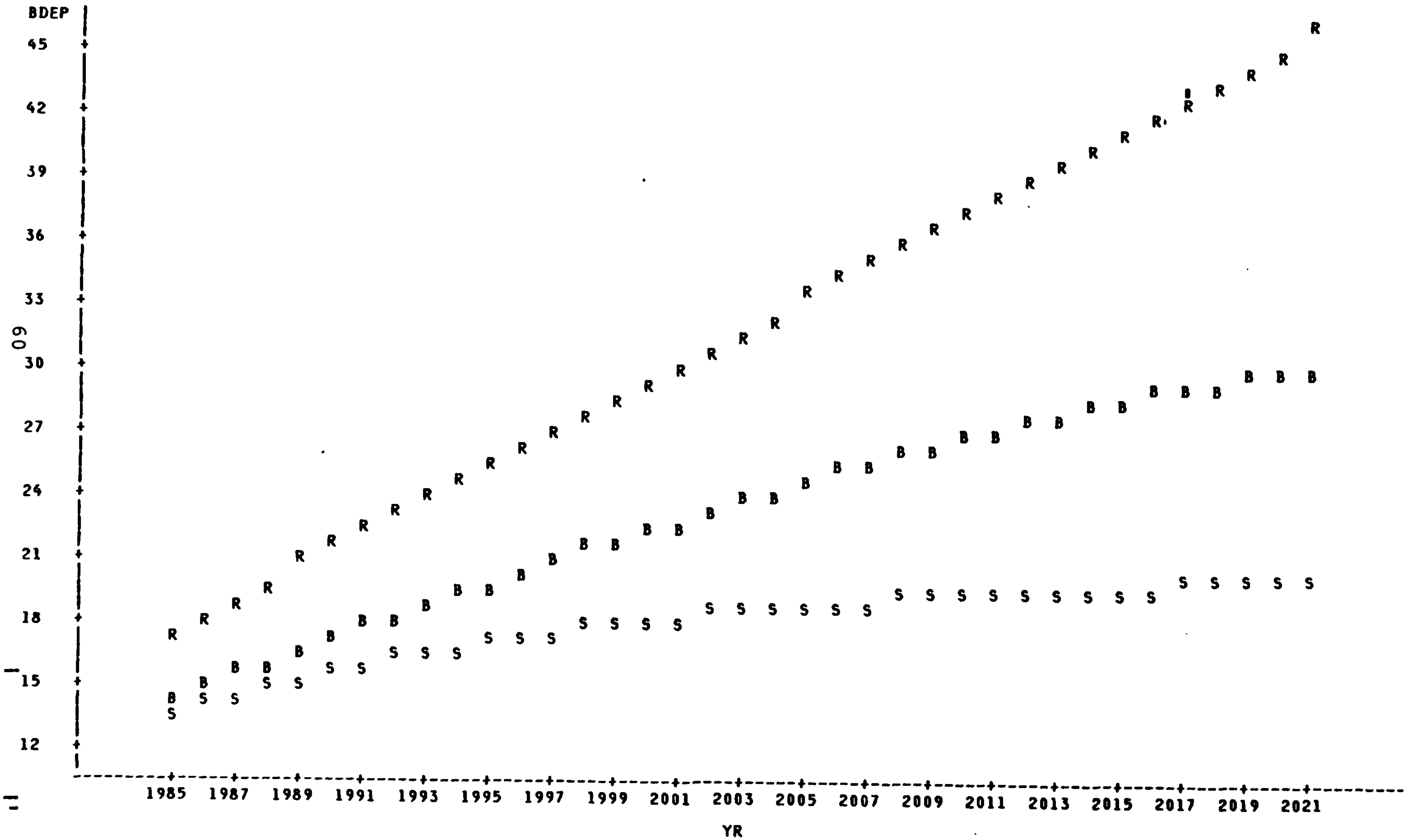

FIGURE 20

TOTAL OVERS BY SCENARIO 17:06 MONDAY, DECEMBER 8, 1980

PLOT OF BOVERS*YR SYMBOL USED IS B
PLOT OF ROVERS*YR SYMBOL USED IS R
PLOT OF SOVERS*YR SYMBOL USED IS S

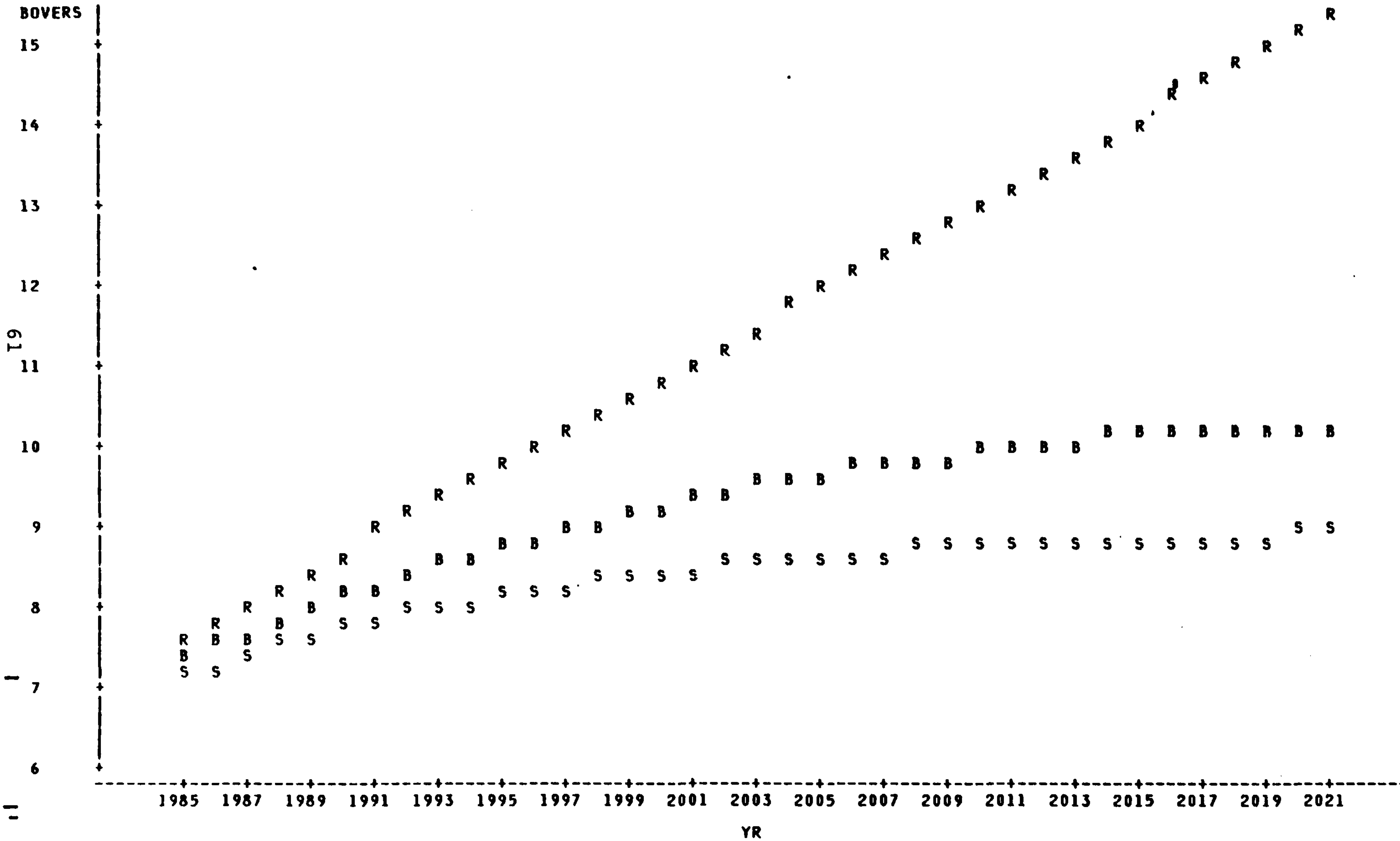

FIGURE 21

which in turn creates a demand for more general aviation transportation, is associated with the Rapid Growth and Balanced Growth Scenarios. The increased number of operations at Air Route Traffic Control Centers reflects the phenomena associated with the scenarios discussed above. As illustrated in Figures C-10, C-11, and C-12, the curves representing the Rapid and Balanced Growth Scenario assume higher values in comparison to the Stagflation Scenario Curve.

APPENDIX A

FORECAST METHOD

APPENDIX
FORECAST METHOD

The purpose of this section is to describe the method employed to forecast levels of aviation activity. As noted in previous sections, the purpose of this project is to estimate the nature and, to the extent possible, the magnitude of primary effects emanating from the introduction of new aviation communication technology.

The adoption rate of new technology will be in part influenced by the activity within an industry. In addition, the adoption of new technology may influence the nature and magnitude of industrial activity. As such, identification and estimation of future values for typical industry activity measures are necessary to the assessment of technological effects.

The aviation industry measures included in the scenario forecast derive from FAA Aviation Forecast Fiscal Years 1981-1992.[1] In particular, parameters that describe aggregate activity levels for aircarriers and general aviation must be considered. In addition, measures that reflect the service provided to the industry by the FAA must also be included. As such, the measures of import for this study included:

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[1]Office of Aviation Policy (AVA), "FAA Aviation Forecasts Fiscal Years 1981-1992", U.S. Department of Transportation, Federal Aviation Administration, Washington, D.C. September 1980.

a) total operations

b) local operations

c) itinerant operations

d) general aviation fleet size and composition

e) aircarrier fleet size and composition

f) FAA workload measures

    1) aircraft handles

    2) IFR departures

    3) overs

    4) flight plans filed

    5) aircraft contacts.

In addition to the measures identified above other variables of import included;

a) controller, flight service, and maintenance personnel;

b) FAA investment in traffic control and communications investment.

The relationship of each of the preceding factors to the assessment effort will be described in succeeding sections of the text. The purpose of this section is to describe the general approach used to estimate future values for each of the variables.

The present effort required examination of the technology induced impacts under three socio-economic scenarios: balanced growth, rapid growth and stagflation. The analytic differences among scenarios are measured in terms of economic variables. The

economic variables of import for this project are those employed in the "FAA Aviation Forecast" i.e., Disposable Personal Income (DPI), Gross National Product (GNP) and Employment (Employ).[2] A review of the FAA Forecast indicated the official estimates represented the balanced growth scenario. The upper and lower bound FAA estimates were deemed equivalent to the rapid growth and stagflation scenarios.[3] The economic variables developed used in the scenarios are shown in the scenario section of the report.

The general method used to forecast aviation activity and FAA workload measures included:

1) examine the official FAA forecast

2) develop linear approximations of activity and workload measures

3) develop time series estimates of activity and workload measures

4) forecast aviation and workload measures based upon time series estimates.

The official forecast[4] is based upon numerous analytic models. The estimates provided by the analytic models are reviewed by appropriate agency personnel. The analytic estimates are modified based upon the expert judgement of the FAA personnel. As such,

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[2]Ibid, page 61.

[3]Ibid, AVP, pages 28-35.

[4]Ibid, AVP.

it was decided that forecast for this project would derive from analog models. The analog models employ the economic assumptions embodied in the FAA forecast as well as the official FAA estimates. The use of such analogs allow one to incorporate the expert judgement of agency personnel embodied in the official estimates. See Table 1.

Histograms for several of the official estimates (e.g. operations, pilots, aircraft) were developed by the project team. A review of the histograms indicated that on surface the time series relationships were linear. However, further examination suggested that the historic data as well as the latter portion of the official forecast were non-linear. The most likely analog form for forecasting was the logistic curve.

An illustration of the difference between a linear and logistic curve approximation is shown in Figure 1. The general form of a linear approximation is:

$$Y = At + B$$

where Y = dependent forecast variable

t = independent time variable

A = slope of the curve

B = intercept

The logistic curve is defined as

$$Y = \frac{A}{(1 + e^{(B + Ct)})}$$

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where Y = dependent forecast variable

t^* = independent time variable, and

A, B, C are empirically determined coefficients.

As indicated in Figure 1 the linear and logistic forms may be congruent for some portion of the forecast period. However, the logistic form yields more conservative estimates than the linear form for extended time periods. As such, the logistic function tends to conform with the caution imported by expert judgement.

As noted above the development of forecast equations was a three step process. The first step was the development of linear approximations for aviation activity and agency workload measures. In as much as the differences among scenarios are measured in terms of economic variables, the initial linear approximations were of the form

aviation activity or workload measure = function (economic variables)

Linear regression equations for the official baseline forecast data were developed using a stepwise regression program. The linear approximations were obtained for the appropriate historic data period to fiscal 1992. The relationships developed using the stepwise procedure and the attendant statistics are shown in Tables 3-19. Table 20 defines the terms used throughout this section. Based upon the equations developed in this step and the scenario economic variables, estimates were prepared of future aviation activity and workload measure. That is, the values for

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Illustration of Linear and Logistic Forms

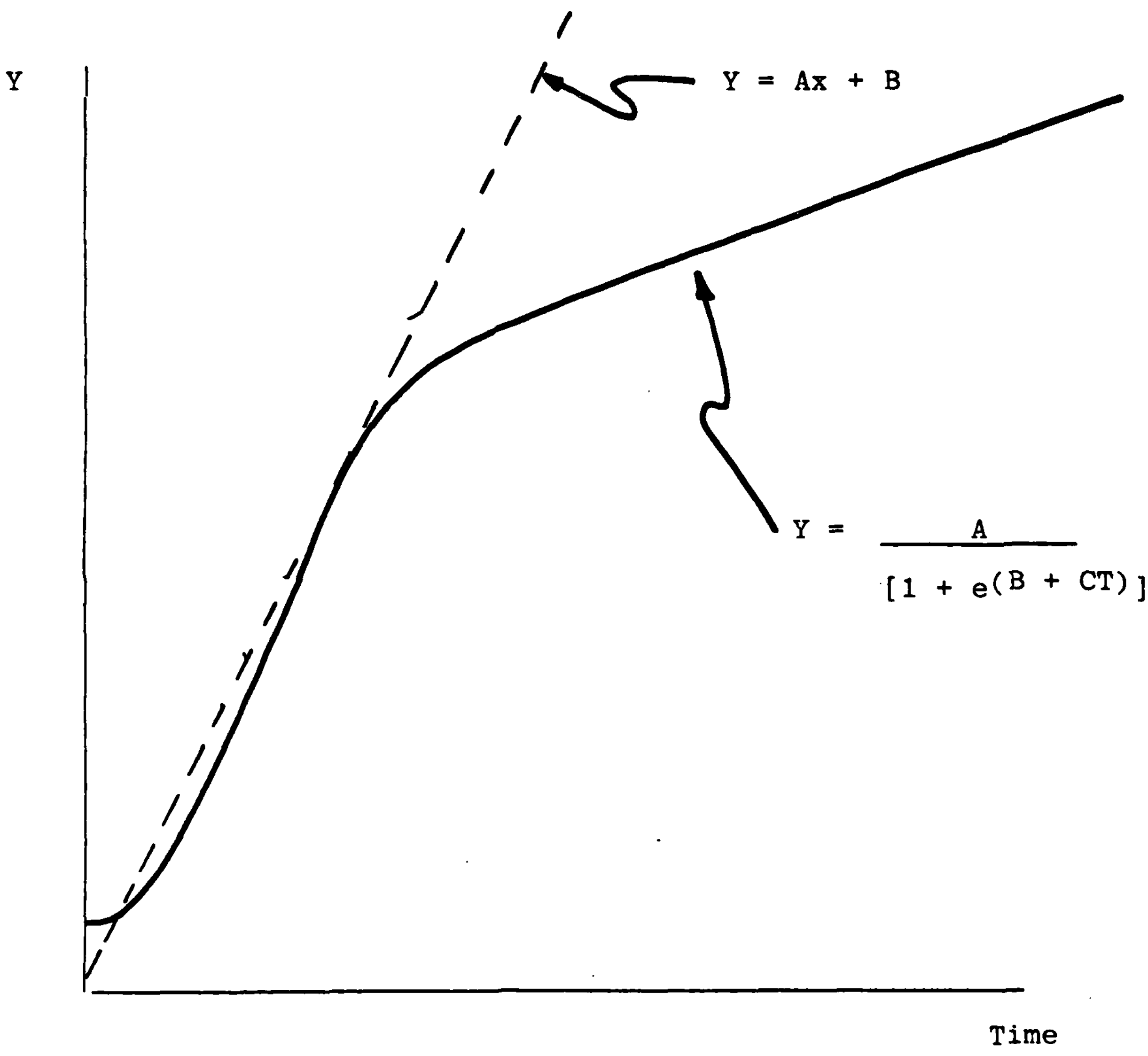

Figure A-1

Table A-1

LINEAR APPROXIMATIONS OF OFFICIAL BASELINE FORECAST 1970-1972

A. Number of Aircraft

TOTGA	=	-319.5067	+	5.5072 Employ	
(t)		(-17.94)		(31.49)	R^2 = .984
SEGA	=	-226.2078	+	4.1067 Employ	
(t)		(-18.00)		(33.27)	R^2 = .986
MEGA	=	-30.4632	+	.5690 Employ	
(t)		(-10.32)		(19.63)	R^2 = .960

B. Operations

TOPS	=	- 7.4334	+	.0549 GNP	
(t)		(-2.57)		(28.79)	R^2 = .975
LOPS	=	5.4211	+	.0133 GNP	
(t)		(5.96)		(22.12)	R^2 = .959
ITOPS	=	-12.8037	+	.0416 GNP	
(t)		(-6.06)		(29.85)	R^2 = .977

C. FAA Air Route Traffic Control Centers

TAIRHAND	=	-10.3391	+	.0283 GNP	
(t)		(-8.12)		(33.64)	R^2 = .982
TOVERS	=	- 3.8307	+	.1072 Employ	
		(-9.30)		(25.43)	R^2 = .968
IFRDEP	=	- 5.0314	+	.0171 DPI	
		(-9.41)		(33.56)	R^2 = .982

Table A-1
(Continued)

D. Flight Service Station (FSS)

PLTBRF	=	-10.1438	+	.0297 DPI	
(t)		(-15.42)		(47.56)	R^2 = .991
TOTFSS	=	-25.3077	+	.0660 GNP	
		(-11.75)		(46.41)	R^2 = .990
TOTFLTPL	=	-17.0895	+	.2879 Employ	
		(-14.93)		(24.60)	R^2 = .966

E. Pilots

TOTPLT	=	68.0713	+	.7568 DPI	
(t)		(3.24)		(40.06)	R^2 = .990
PRIVPLT	=	64.3252	+	.1951 GNP	
(t)		(6.80)		(32.96)	R^2 = .985
TRANPLT	=	-85.2893	+	.1024 GNP	
(t)		(-16.05)		(30.84)	R^2 = .983
STUPLT	=	82.4102	+	.1203 DPI	
(t)		(10.80)		(17.51)	R^2 = .950

Table A-2

LIST OF FORECAST EQUATIONS

NAME	BG	RG	SF
Total Operations	Logistic	LIN	Logistic
Local Operations	LIN	LIN	LIN
Itinerant Operations	Logistic	LIN	Logistic
Total Active GA Aircraft	Logistic	Logistic	Logistic
Single Engine GA Aircraft	Logistic	Logistic	Logistic
Multiple Engine GA Aircraft	Logistic	Logistic	LIN
Enroute Aircraft Handles	Logistic	Logistic	LIN
IFR Departures	Logistic	LIN	Logistic
Total Overs	Logistic	LIN	Logistic
Flight Services	LIN	LIN	LIN
Flight Plans Filed	LIN	LIN	LIN
Pilot Briefing	Logistic	LIN	LIN
Total Pilots	LIN	LIN	LIN
Student Pilots	LIN	LIN	LIN
Transport Pilot	LIN	LIN	LIN
Private Pilot	LIN	LIN	LIN
Linear Approximations 1970–1992			
Number of Aircraft	LIN	LIN	LIN
Operations	LIN	LIN	LIN
FAA Air Route Traffic Control Centers	LIN	LIN	LIN
Flight Service Station	LIN	LIN	LIN
Pilots	LIN	LIN	LIN
Controller Staffing			
Center Controllers	LIN	LIN	LIN
Terminal	LIN	LIN	LIN
Total Aircraft	LIN	LIN	LIN
Employment	Logistic		

Note: BG = Balanced Growth
RG = Rapid Growth
SF = Stagflation

the economic variables for the stagflation and rapid growth scenarios were substituted in the equations to calculate appropriate values for activity and workload measures under each social scheme. The forecast for aviation activity and workload measures for each scenario is presented in Volume 2.

In summary, the effort under this step provided estimates of aviation activity and workload fiscal measures for each scenario for the period 1981 to 1992. The estimates of independent variables obtained in the preceding element were used to develop the long range time series forecast equations for each scenario. It was assumed initially that all long range forecast equations would be logistic in form. Time series logistic equations were developed for aviation activity measures under each scenario using a non-linear regression program.[5] In the event a logistic form could not be developed for a specific variable, linear time series were constructed.

The variables forecast and attendant form of the equation are shown in Table 2. The specific forecast equations for each variable under each scenario, as well as the appropriate forms of the equations, and the statistics are shown in Tables 3 to 18. The equations for controller staffing are shown in Table 19.

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[5]SAS/ETS User's Guide, Economitric and Time Series Library, 1980 Edition. (SAS Institute, Inc. Box 8000, Cary, North

Table A-3

TOTAL OPERATIONS

$$TOPS = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	217.422	1.1794	-.0464978	2.75	2.57	-5.04	.9866
RAPID GROWTH*	42.06195	3.6125		14.77	16.3		.927
STAGFLATION	115.085	.2268	- .0704	10.31	1.49	-5.73	.978

*TOPS = A + Bt

Table A-4

LOCAL OPERATIONS

LOPS = A + BT

SCENARIO	COEFFICIENT		T-TEST COEFFICIENT		R^2
	A	B	A	B	
BALANCED GROWTH	19.27934783	.53942688	62.66	22.52	.9602
RAPID GROWTH	17.4445	.8687	22.77	14.56	.909
STAGFLATION	19.8663	.4371	69.73	19.71	.948

Table A-5

ITINERANT OPERATIONS

$$ITOPS = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	116.763	1.00352	-.06129	5.86	4.66	-7.48	.9899
RAPID GROWTH*	25.5293	2.7858		17.6	24.07		.967
STAGFLATION	75.509	.344869	-.0830935	14.08	3.41	-7.56	.983

*ITOPS = A + Bt

Table A-6

TOTAL ACTIVE GA AIRCRAFT

$$TOTGA = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	423.408	.499462	-.0913394	36.35	12.84	-25.88	.999
RAPID GROWTH	730.159	1.2848	-0.0722	5.11	5.43	-9.14	.995
STAGFLATION	292.358	-0.1376	-0.1598	82.64	-5.83	-19.81	.996

Table A-7

SINGLE ENGINE GA AIRCRAFT

$$SEGA = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	322.367	.383956	-.090896	35.18	9.14	-22.64	.9989
RAPID GROWTH	571.26	1.22583	-0.06826	5.03	5.00	-3.86	.996
STAGFLATION	229.578	-.228004	-0.159498	85.90	-9.51	-19.13	.996

Table A-8

MULTIPLE ENGINE GA AIRCRAFT

$$MEGA = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	56.278	.654517	-.0695712	6.20	2.85	-6.26	.9911
RAPID GROWTH	121.117	1.66585	-0.05487	1.91	2.73	-5.93	.994
STAGFLATION*	19.3918	.70619		56.83	19.60		.960

*MEGA = A + Bt

Table A-9

ENROUTE TOTAL AIRCRAFT HANDLES

$$TAIRHAND = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	75.6104	1.04135	-.0643708	5.96	5.01	-7.58	.9893
RAPID GROWTH*	15.1173	1.8667		10.51	16.66		.929
STAGFLATION	49.8075	0.4213	-.0847	13.22	4.06	-7.46	.98

*TAIRHAND = A + Bt

Table A-10

IFR DEPARTURES

$$IFRDEP = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	34.8919	1.26932	-0.06176	5.17	5.51	-8.43	.992
RAPID GROWTH*	5.5304	0.7972		8.47	15.68		.9212
STAGFLATION	20.5815	0.5264	- 0.0835	13.41	5.33	-8.42	.986

*IFRDEP = A + Bt

Table A-11

TOTAL OVERS

$$TOVERS = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	10.5991	.308615	-.0754902	7.85	1.63	-4.44	.9583
RAPID GROWTH*	4.3717	0.2160		42.26	26.82		.972
STAGFLATION	8.9972	0.0016	-0.0912	12.29	.01	-4.46	.9432

*TOVERS = A + Bt

Table A-12

FLIGHT SERVICES

FSS = A + BT

SCENARIO	COEFFICIENT		T-TEST COEFFICIENT		R^2
	A	B	A	B	
BALANCED GROWTH	43.6336	2.6736	50.07	39.41	.986
RAPID GROWTH	34.519	4.3016	9.58	15.34	.918
STAGFLATION	46.5391	2.1581	77.82	46.36	.990

Table A-13

TOTAL FLIGHT PLANS FILED

TOTFLTPL = A + BT

SCENARIO	COEFFICIENT		T-TEST COEFFICIENT		R^2
	A	B	A	B	
BALANCED GROWTH	5.4423	0.4945	36.13	42.17	.9883
RAPID GROWTH	5.0467	.5633	19.65	28.17	.974
STAGFLATION	5.992	.4010	36.62	31.49	.9792

Table A-14

PILOT BRIEFING

$$PLTBRF = \frac{A}{[1 + e^{(B + Ct)}]}$$

SCENARIO	COEFFICIENT			T-TEST COEFFICIENT			R^2
	A	B	C	A	B	C	
BALANCED GROWTH	89.8603	1.83659	-.0538404	2.38	3.91	-7.46	.9922
RAPID GROWTH*	8.4652	1.3628		7.15	14.78		.9123
STAGFLATION*	12.3739	.6699		68.17	47.41		.991

*PLTBRF = A + Bt

Table A-15

TOTAL PILOTS

TOTPLT = A + BT

SCENARIO	COEFFICIENT		T-TEST COEFFICIENT		R^2
	A	B	A	B	
BALANCED GROWTH	707.75	22.6979	177.62	56.73	.995
RAPID GROWTH	633.3929	42.6067	25.02	16.76	.9461
STAGFLATION	730.7695	16.9218	130.75	30.15	.9827

Table A-16

STUDENT PILOT

STUPLT = A + BT

SCENARIO	COEFFICIENT		T-TEST COEFFICIENT		R^2
	A	B	A	B	
BALANCED GROWTH	184.1409	3.6023	91.57	17.84	.9521
RAPID GROWTH	172.000	6.8549	46.70	18.54	.9555
STAGFLATION	187.4801	2.7716	76.11	11.20	.886957

Table A-17

TRANSPORT PILOT

TRANPLT = A + BT

SCENARIO	COEFFICIENT		T-TEST COEFFICIENT		R^2
	A	B	A	B	
BALANCED GROWTH	38.4269	4.5236	70.20	82.29	.9976
RAPID GROWTH	24.7584	8.2218	5.8[illegible]	19.25	.9586
STAGFLATION	42.8263	3.4027	29.5	23.34	.9714

Table A-18

PRIVATE PILOTS

PRIVPLT = A + BT

SCENARIO	COEFFICIENT		T-TEST COEFFICIENT		R^2
	A	B	A	B	
BALANCED GROWTH	299.4385	8.6150	249.37	71.45	.9968
RAPID GROWTH	273.3567	15.676	33.62	19.20	.958
STAGFLATION	307.8338	6.4747	108.05	22.63	.9697

Table A-19

CONTROLLER STAFFING EQUATIONS

A. Center Controllers

(1) $\text{CENT} = -5215.64 + 6.3305\text{TAC}$

(t) (-7.09) (24.43) $R^2 = .973$

(2) $\text{TERM} = 5204.604 + 34.790\ \text{TOTGA}$

(t) (6.67) (8.19) $R^2 = .9437$

B. Total Air Carrier Aircraft

$\text{TAC} = 1216.9761 + 1.4659\ \text{DPI}$

(t) (14.05) (18.80) $R^2 = .957$

C. Employment

$$\text{Employ} = \frac{A}{[1 + e^{(B + Ct)}]} \qquad R^2 = .9944$$

A = 140.17 (t = 23.00)
B = -.204435 (t = -2.32)
C = -.0580251 (t = -9.78)

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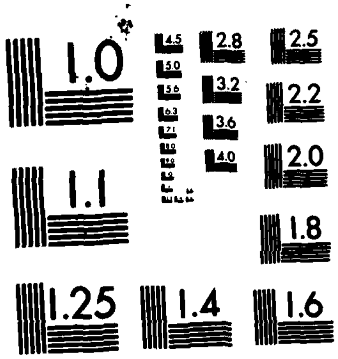

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table A-20

DEFINITION OF TERMS

TERM	DEFINITION
EMPLOY	Employment
TOTGA	Active total general aircraft
SEGA	Single engine general aircraft
MEGA	Multiple engine general aircraft
TOPS	Total operations
LOPS	Local operations
ITOPS	Itinerant operations
GNP	Gross National Product
DPI	Disposable Personal Income
TAIRHAND	Total enroute air handles
TOVERS	Total overs
IFRDEP	IFR departures
PLTBRF	Pilot briefing
TOTFSS	Flight services
TOTFLTPL	Flight plans filed
TOTPLT	Total pilots
PRIUPLT	Private pilots
TRANPLT	Transport pilots
STUPLT	Student pilots
CENT	Center staff
TAC	Tactical Air Command
TERM	Terminal staff
FSS	Flight service center